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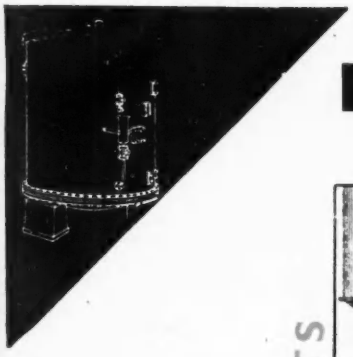
# The Chemical Age

**A Weekly Journal Devoted to Industrial and Engineering Chemistry**

VOL. XLVI. No. 1185. SATURDAY, MARCH 14, 1942. 6D. PER COPY: POST FREE 8D.

REGISTERED AS A NEWSPAPER

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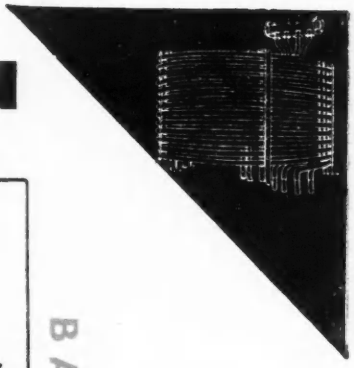

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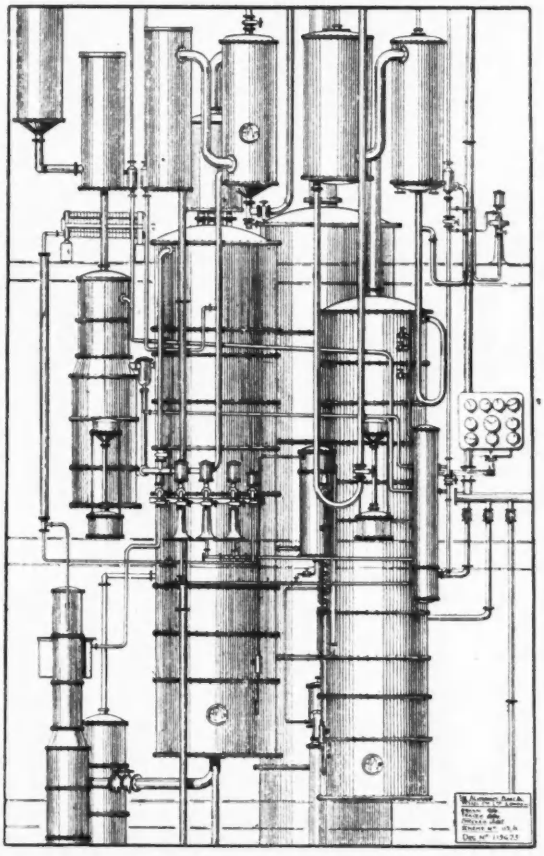

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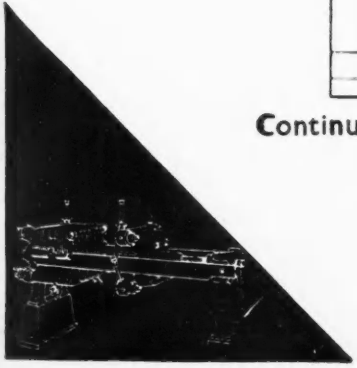

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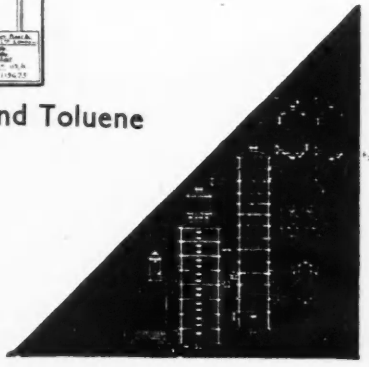

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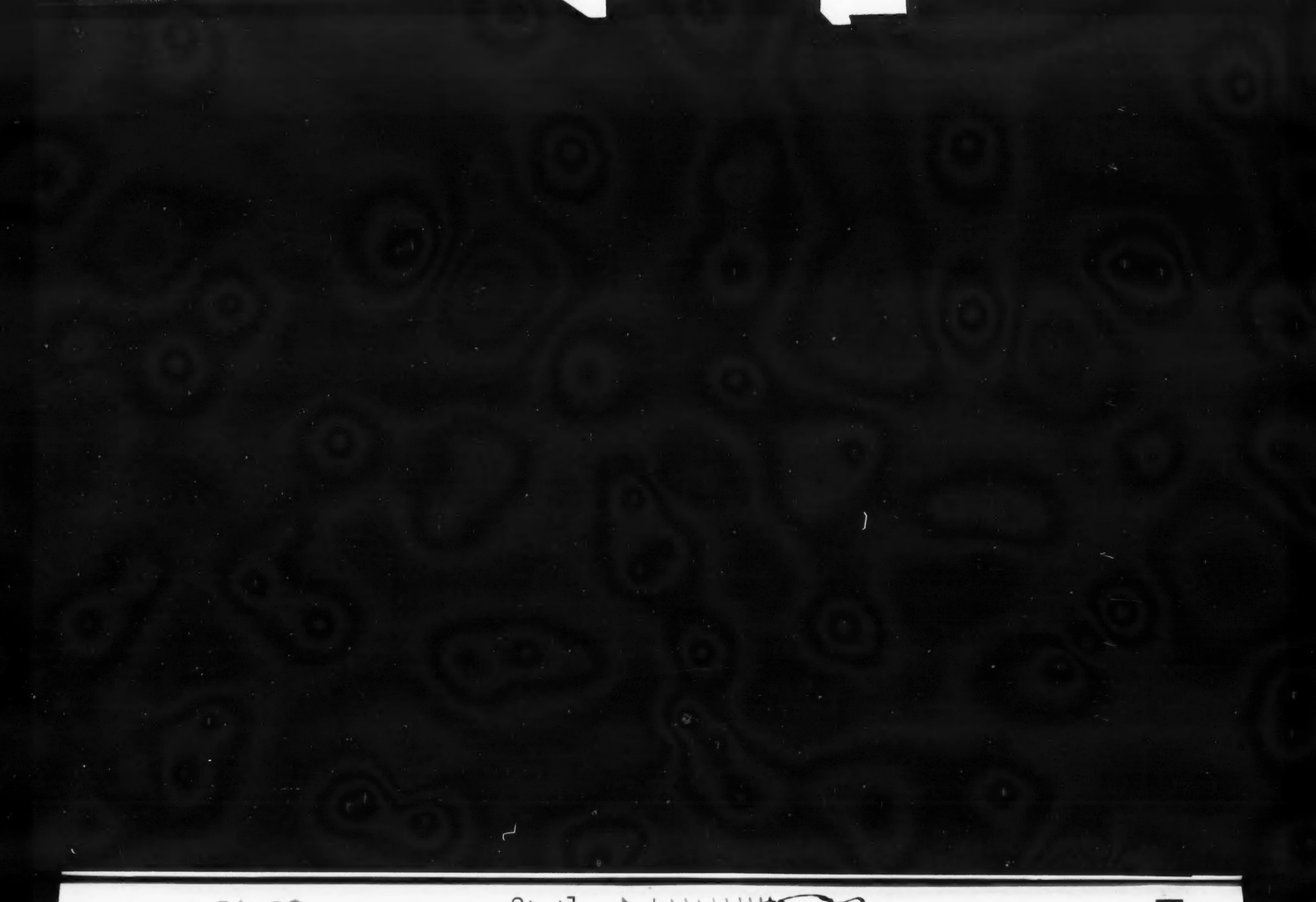

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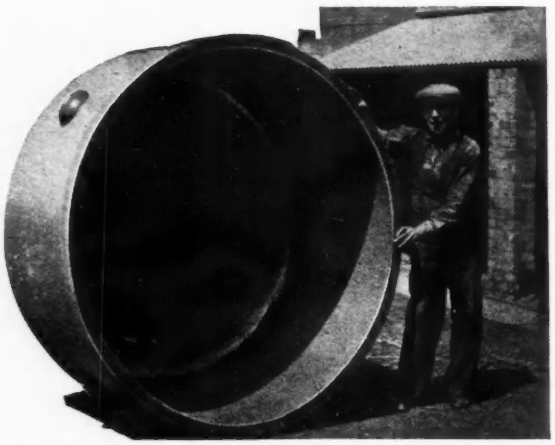

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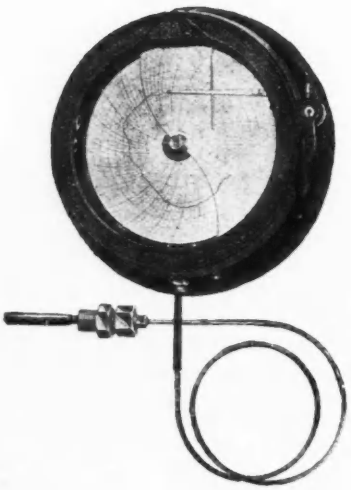

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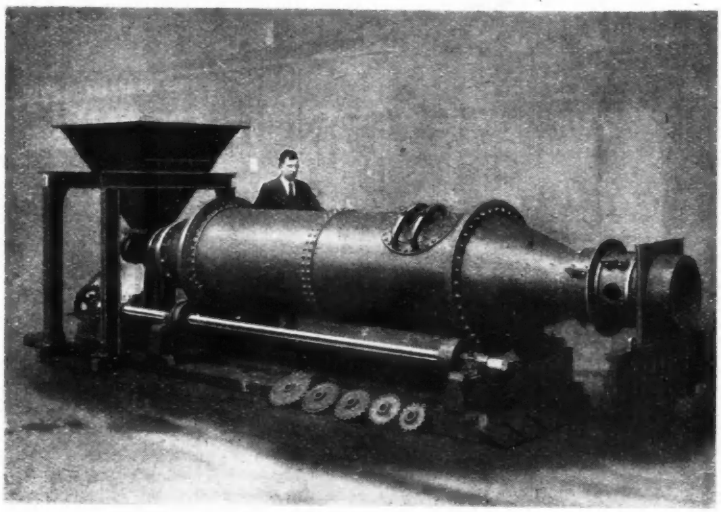

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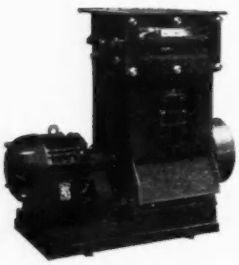

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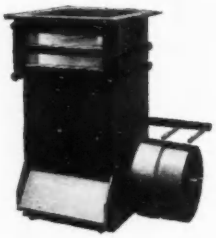

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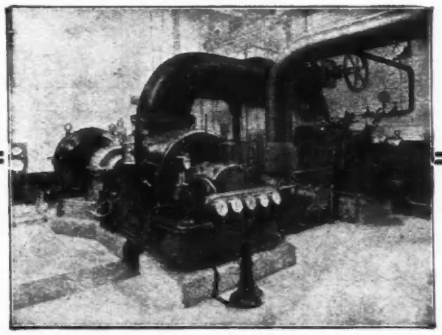

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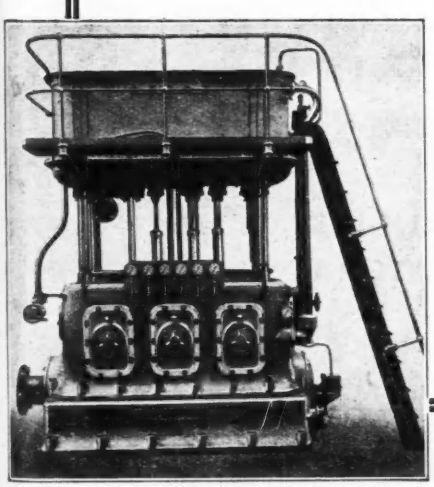

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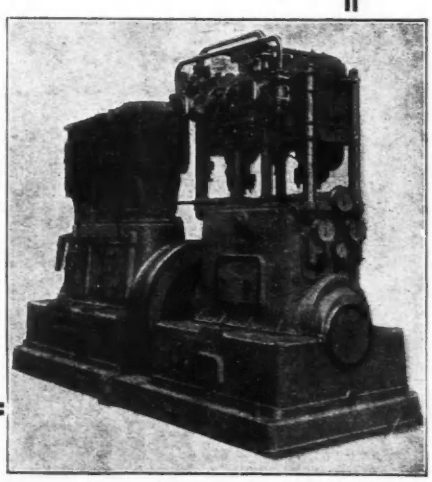

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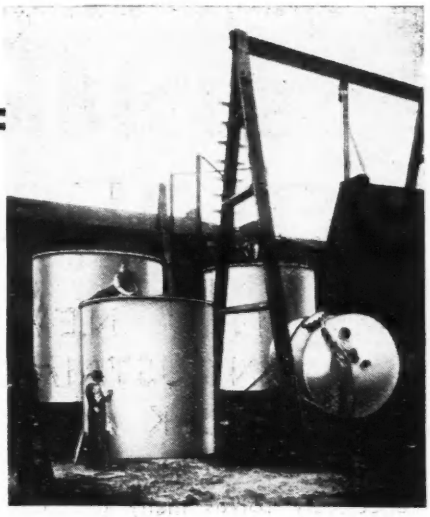

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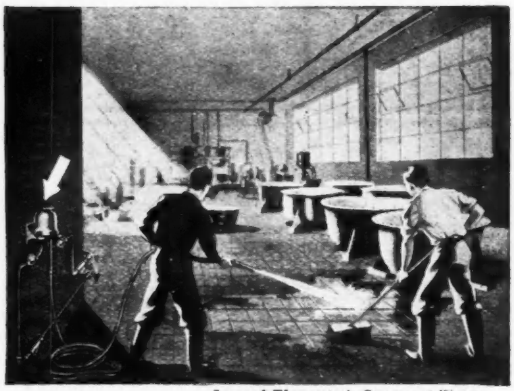

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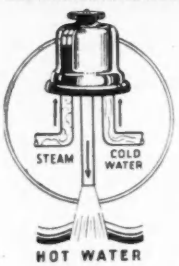


**Instant Hot Water**
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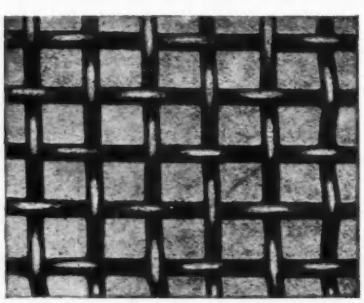

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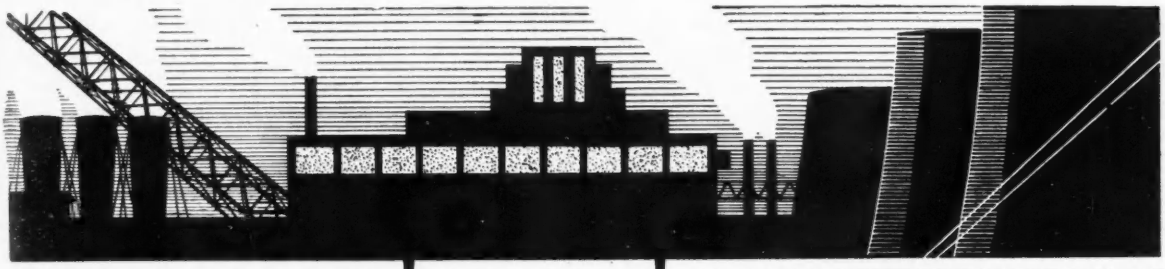

# AUTOMATIC 'WORKS' MAINTENANCE

What are the prime essentials of the "works" of any Chemical Plant Installation, *i.e.*, the valves, vessels, pipelines, etc. ? Surely these—

1. **Constantly-maintained resistance to corrosion.**
2. **Valvular working parts always mobile, without sticking.**
3. **Prevention of leakage.**

Audco Practice ensures all these desiderata automatically by means of :—

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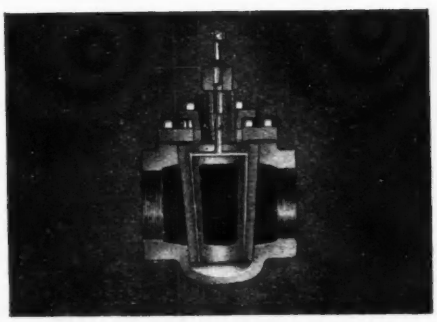
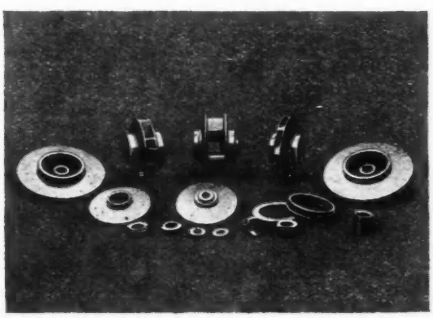
Made in a variety of materials—Stainless, Acid-resisting bronzes, "Audcoloy" and "Hysil" Glass, embodying the exclusive Audo-Lubri-sealed principle that maintains a constant film of lubricant over all working surfaces, thus ensuring—

**NO STICKING**
**NO CORROSION**
**NO LEAKAGE**



Sectional view of a standard "AUDCO" Valve showing the patented lubricating system.

1. Baking finish for lining all types of chemical plant subject to corrosion, giving a smooth, hard, glass-like surface, which is both odourless and sterile and easily cleaned.
2. Air-drying finish, for application by spraying or brushing to structural steel-work, wood, concrete, etc., in contact with corrosive atmospheres.



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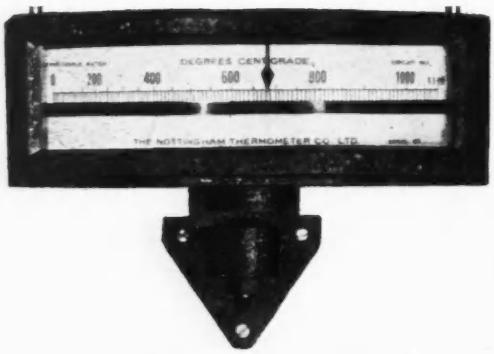


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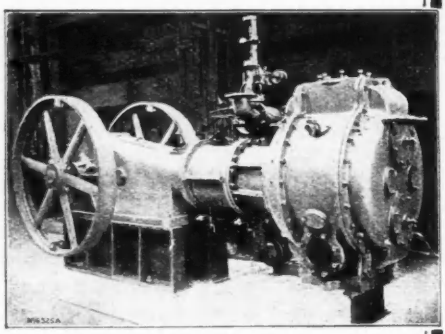

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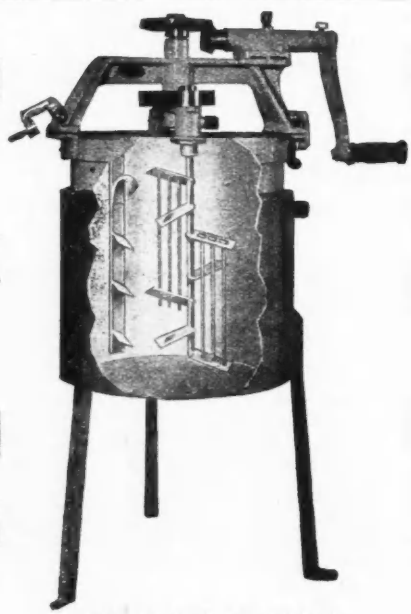

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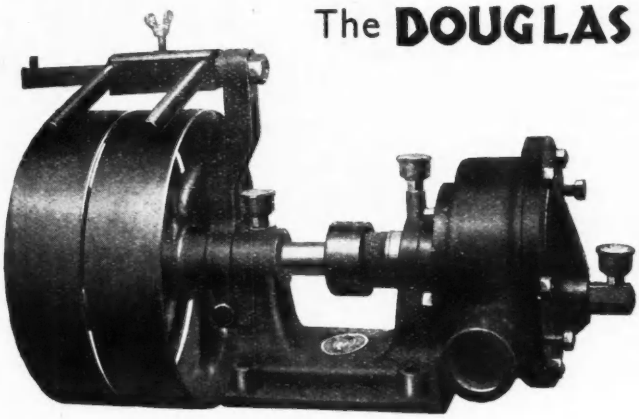

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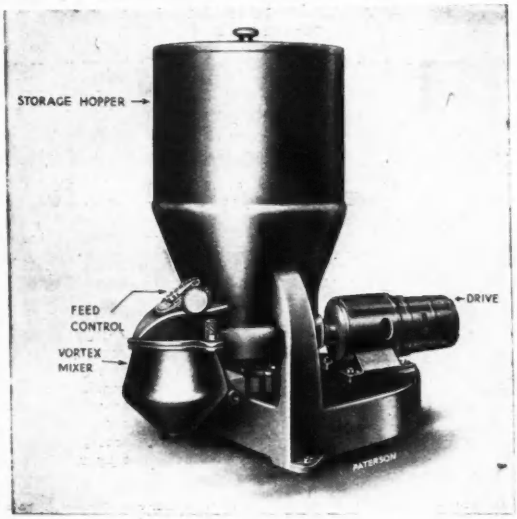


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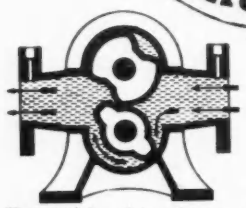

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ACTUAL BATCH ANALYSIS
(Not merely maximum impurity values)

Batch No. 10001

| | |
|---|---|
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| Chloride (Cl) | 0.00005% |
| Sulphate ($SO_4$) | 0.0001% |
| Heavy Metals (Pb) | 0.0001% |
| Iron (Fe) | 0.00007% |
| Bromine Absorbed (Br.) | 0.004% |
| Oxygen Absorbed (O) from dichromate | 0.0008% |
| Arsenic" ($As_2O_3$) | 0.1 p.p.m. |

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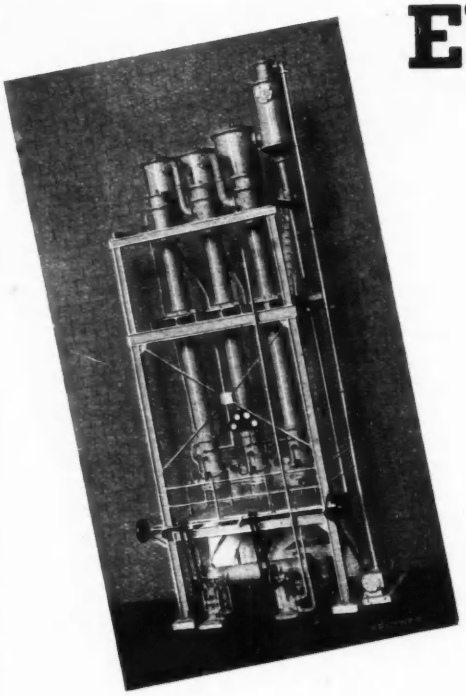

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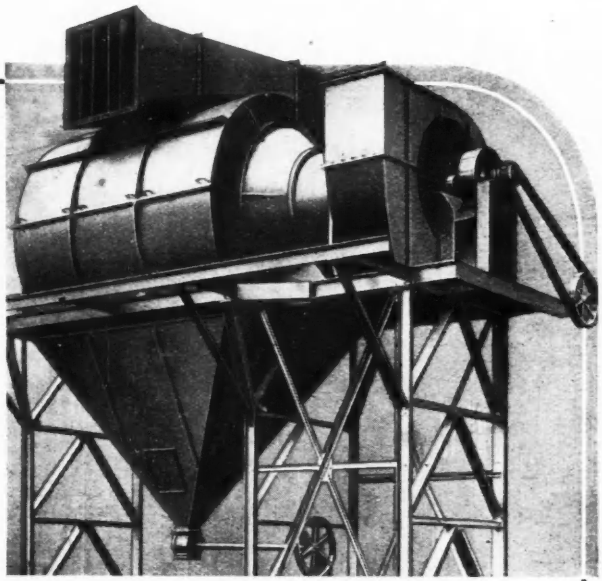

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VOL. XLVI. No. 1185 March 14, 1942 Annual Subscription, 21s. Overseas, 26s.

# The Protection of Steelwork

MOST works maintenance consists of an endeavour to prevent materials from passing from the state of high potential to which they are raised by manufacturing processes to a state of low potential in which they will be useless for the purposes for which they are required. Applied to iron and steel this is essentially a protection against rusting or corrosion due to the presence of deleterious gases in the atmosphere. The Corrosion Committee of the Iron and Steel Institute has had this problem under examination for some 14 years, and in view of the vast increase in steel output under war conditions, it has published its essential findings concerning the protective painting of constructional steelwork, even though some aspects of this subject are still under investigation.

The correct surface preparation of steelwork prior to painting is by far the most important factor in determining the success of the protective coating. An incorrectly prepared surface may last for little more than six months, whereas under exactly identical conditions a correctly prepared surface may be expected to last from seven to nine years. The Committee, therefore, emphasises that even with to-day's need for rapid production, it is not good practice to skimp the time devoted to surface preparation.

The practice of industry in painting steel structures varies considerably and it is useful to have a guide to what is good practice and what is either less good or definitely bad. The first essential is that the material shall be properly descaled and painted at the steel works before being sent out. It is often considered sufficient to paint over the mill scale in the belief that the mill scale is itself a protection. If surfaces were completely covered with mill scale this protection might be achieved, and it sometimes happens that steps are taken to preserve the mill scale as far as possible by avoiding undue exposure of steel to the weather and by applying a thin protective coating to the surface at the first available opportunity. The Committee finds, however, that over large areas under practical conditions mill scale rarely forms a complete covering of the bare metal; moreover there is a tendency for it to rise in places beneath the paint film and to cause blisters or failures.

Three methods of descaling are in use, and of these pickling and sand- or shot-blasting are both regarded as the practice to be adopted wherever possible. There is some advantage in the Duplex process of pickling in which the steelwork is rinsed in water after descaling in sulphuric acid and then dipped in dilute phosphoric acid containing iron phosphate. The phosphate retards the development of rust and affords a good surface for painting. While shot-blasting is generally approved difficulty is sometimes found in removing all the rust from the surface, especially where the steel has been previously allowed to rust and the surface is pitted. The coarse shot particles may bridge the mouth of the pit and hammer the rust into the surface without removing it. Rust retained on the surface may under certain conditions stimulate further corrosion.

A method often adopted on works is to allow mill scale to flake off by weathering, this being followed by chipping, scraping, and wire-brushing. This method is most unreliable and with one exception is regarded as the worst method of preparing iron and steel surfaces for painting. The worst method of all is to stimulate the weathering artificially by moistening the surface at intervals with solutions such as calcium chloride. Traces of the deliquescent salt appear to become locked up in the rust and become intense centres of corrosion.

Any freshly descaled iron or steel surface tends to rust immediately, and this tendency is particularly pronounced in the humid and polluted atmosphere common in this country. The interval allowed to elapse between removal of the mill scale and painting should therefore be as short as possible. Best results are obtained when the priming coat is applied immediately after pickling and washing, but storage *indoors* for periods of up to 30 days is not found to cause any serious loss of durability. All depends, of course, upon the conditions of storage. The best procedure is undoubtedly to apply the priming coat of paint immediately after descaling. The descaled steel must, of course, be rinsed either with hot or cold water. Proprietary washes are sold which are claimed to have the power of preventing rusting underneath paint coats or of neutralising bad effects of existing rust on a structure that is to be repainted. These washes, which generally contain phosphoric acid and or compounds of chromium, are not recommended by the Committee. They regard the removal of scale and rust by pickling or mechanical means as the only safe procedure and they consider it bad practice to allow the steel to rust before painting it.

There are occasions when descaling cannot be carried out, and although removal of mill scale by weathering cannot be regarded as generally satisfactory it may be of some assistance in such circumstances provided that, in the words of the Committee, "those responsible are reconciled to a greatly reduced life of the initial painting and are prepared to renew the painting after, say, a year's exposure." Under such conditions one, or at the most, two coats of paint are applied initially and the structure is thoroughly cleaned down

before repainting. An alternative method also, only applicable in the special circumstances mentioned, is to endeavour to retain the mill scale intact by measures which have been mentioned previously.

The Committee is emphatic in its condemnation of efforts to cheapen the cost of painting by buying cheap paints. They point out that in their own experiments the cost of paints was 0.55d. per sq. ft., whereas the labour for cleaning and painting was 6.2d. per sq. ft., so that quality or protective power of the paint should be the first criterion. All the painting tests conducted by the Committee have agreed in showing that the best results are obtained when the paint applied directly to iron and steel is pigmented with inhibitive materials that repress the tendency of the steel surface to corrode. Among the pigments known to have inhibitive properties are red lead, white lead, lead chromate, blue lead (basic sulphate of lead), zinc chromate and other sparingly soluble chromates, zinc dust, and possibly zinc oxide. The most effective of these is red lead. The best general finishing paints available in quantity for use over red lead are red oxide of iron, white lead, and micaceous iron ore. During the war emergency particularly, alternatives to the linseed-oil paints mentioned should be considered; chief amongst these will be tar paints. The merit of tar, especially in coastal and marine conditions, has long been established, and the extended use of tar should be considered as a means of reducing imports, while at the same time maintaining the protection of structures undiminished. Red lead and tar used in combination provide excellent protection; one coat of red lead followed, after an interval of not less than a month, by one coat of tar which has been neutralised with lime and treated with tallow is a scheme that has been used with much success. All painting should be carried out under dry conditions when the air is reasonably warm, say 60° F. or more, and the humidity is below 90 per cent.

In repainting old steelwork the guiding principle is that no rust should be allowed beneath the original coat of paint. An existing paint film on structural steel should therefore never be allowed to deteriorate to such an extent that rusting occurs beneath it. If this happens, extensive cleaning and scraping to the bare metal will be necessary, a course which in practice does not secure a completely cleaned surface. As soon, therefore, as the paint film begins to show signs of failure, whether by chalking, cracking, blistering, or under-rusting, an additional coat of paint should be applied over it. If failure is adjudged to have occurred as a result of blistering or under-rusting, the latter of which will be revealed by rust stains, care should be taken to make sure that the old paint film is perfectly sound and adherent; if not, it should be removed. Paint in a sound condition should not be unnecessarily removed. If deterioration of the old paint film has been allowed to take place and actual rusting has occurred, it may be necessary to remove the old paint as well as the rust. A flame-descaling process may be useful in this connection; in essentials this consists in burning off the paint with a wide, multi-jet, oxy-acetylene burner, which is passed over the surface of the structure. The steel is heated and is painted while it is still warm. Although final experimental evidence is not yet available, there is reason to believe that the deleterious effect of any remaining rust is diminished by this treatment.

# NOTES AND COMMENTS

## Maintenance and Defence

WE have had the honour of being personally acquainted with several maintenance engineers; and we have found them without exception to be men of sound intelligence and unruffled temperament. If they read the news to-day—and being men of intelligence they certainly will—they will realise that their position is one of vital and growing importance, not merely to the welfare of British industry (for that is always so), but actually to the existence of the country. The Japanese advances in the Far East have deprived us, no doubt only temporarily, of large supplies of commodities essential to the chemical and metallurgical industries—after tin, tungsten; after tungsten, teak. It is to be supposed that we possess large accumulated stocks of these commodities, held in reserve in this country; nevertheless the duty of maintaining in good order plant and equipment incorporating these materials looms daily more massive on the industrial horizon. While the research chemist in his laboratory is evolving new products to replace those of which there is a shortage, the maintenance men in the works have the honourable task of keeping existing plant ready for extra loads of work. Theirs is the key position which must be held at all costs until the new materials are ready to arm the hands of industry in the final victorious offensive.

## Trade Press Policy

SOME of our readers will have noticed that announcements of THE CHEMICAL AGE have appeared in a number of national and provincial newspapers during the past week. Since 1880 the journals of the House of Benn have circulated among industries covering more than half the output of Great Britain. Manufacturers, wholesalers, and retailers, ranging from producers of the smallest appliance for the home to the heaviest plant in the engineering industry, read one or other of the twelve trade and technical papers which are published from Bouverie House. Several of these cater specially for the Empire and allied markets, and two developments may be mentioned to show that publishing enterprise is surmounting every obstacle in carrying the message of British industry overseas, even in war time. The Anglo-Turkish trade agreement of February, 1940, has been followed by *Britanya Sanayii*, a journal published in the Turkish language, which is posted to leading firms throughout Turkey. Similarly, in the case of South America, Benn Brothers now issue a special textile journal in Spanish, as this market continues to absorb a considerable volume of British textile exports. Under present conditions we are compelled to limit subscription lists and to restrict advertising space in most periodicals, but the Benn organisation is maintaining its influential connections throughout the world, ready for further development as soon as the happy day comes to turn swords into ploughshares.

## Soviet-British Co-operation

A CONFERENCE, attended by representatives of 60 British scientific organisations and learned societies, was held last week in the rooms of the Royal Society, and discussed the intensification of the exchange of technical and scientific information between the U.S.S.R. and Great Britain. Sir John Russell, adviser to the Soviet relations branch of the Ministry of Information, was in the chair, and Mr. Ernest Thurtle, M.P., Parliamentary Secretary to the Ministry of Information, opened the proceedings. In response to his lead, when he said that, in stimulating this work, his Ministry felt that it was providing a channel for concrete collaboration between the two nations in the field of science and technical development, it was decided to set up a committee to assist the Ministry in this work and to act as a clearing-house between corresponding organisations in Britain and the U.S.S.R.

# Selection and Maintenance of Chemical Pumps

## Co-operation Between Maker and User

by C. H. BUTCHER

THE movement of liquids at chemical works by means of pumping machinery is a service which has to be put in practice for reasons of greater convenience as well as of working speed. The problems which arise range from the simple transfer of liquid from one open tank to another, to that of handling liquid in a closed system where there is either pressure or vacuum. In other directions there is need to use a pump in feeding filter presses; in keeping liquids in circulation for the purpose of mixing, agitating, scrubbing or washing a gas, spraying, heating or cooling with greater speed than otherwise, and to promote crystal deposition; also for effecting discharge from evaporators and filters operating under vacuum. The liquids to be handled include water, solutions of all concentrations, and chemicals which are of different degrees of viscosity and perhaps hazardous by reason of their inflammability or corrosive nature. Conditions affecting the task of pumping vary with the viscosity of the liquid, its temperature, and the pressure or head against which the pumping effect is to be maintained, as well as the desired speed at which the liquid is to be moved.

### Every Service Has Its Own Problem

Each pumping problem has its own limitations in the matter of efficiency and may demand its particular refinements as regards the construction of the pump. For these reasons alone pump design and construction is rather more complicated than many users appear to think, and when buying a pump for some particular service it is highly essential that there be close co-operation between the maker and the user. The need for a pump may be only too evident to the user, but the pump maker is far more able to appreciate the engineering aspects of the difference between moving cold water along a pipe to an overhead tank and continuous high pressure circulation of liquid at elevated temperature.

The difficulties and intricacies of the problem present themselves to a user of pumping machinery on every occasion when he is confronted with the questionnaire which the pump maker has for the express purpose of gathering all possible data. Only too often the pump user regards much of this desired information as being unnecessary for a proposal and quotation, and in consequence (if he persists in withholding details) he makes it difficult for the pump maker to offer the most suitable pump in the light of present-day knowledge of pump construction and pumping problems. Undue lack of co-operation on the part of the user of chemical machinery has been emphasised more than once, though it is gradually giving way to a common-sense viewpoint; it is probably nowhere more evident than on the occasion of buying a pump.

To recommend a particular pump without knowing just what is expected of it in service at the user's works can add nothing to the reputation of the pump maker, and he may very wisely decline to make a proposal and quotation. For the pump user to make his own selection from the data and illustrations in the maker's printed lists, without asking the maker's advice, is a course that bristles with uncertainties and may well end as sheer folly. If the pump maker is ready to supply the best that pump design and experience can offer, and the pump user knows and explains what his particular problem is, nothing but perfect service can come as the result of close co-operation between the two.

The precise details which are asked for in the pump maker's questionnaire may vary slightly in form and words, but are essentially (1) nature of liquid to be handled, (2) viscosity, (3) temperature, (4) boiling point, (5) specific gravity, (6) character and amount of solid matter present, if any, and related data such as specific gravity of solids and rate of settling. Added to this it is desired to know (7) the suction lift or pressure, and (8) the discharge pressure, with information in both cases as to static, friction loss, diameter and length of pipe, and number of valves or other fittings which the liquid has to pass. The feature of the pumping operation may be simple transfer from one tank to another, circulating (with open or closed system), filter press feeding (in which case it is desirable to know the type of press used), discharging from a vessel under vacuum, or variations of these. Accessory information (all of which is needed if it can be answered) includes a note as to whether any leakage from the pump gland will be objectionable; whether fluid sealing is permissible for the gland; whether water, grease, or any other fluid is preferred as sealing medium; whether the pump is to run continuously or intermittently (and in the latter case the duration of a normal run); whether the pump is likely to be throttled at times for purpose of process control, and to what extent; whether the pump can be located in an alternative position on the plant to reduce the positive suction head if sealing of the gland is not practicable; and whether there are likely to be sudden temperature changes in the liquid handled, and to what extent. Additionally, the maker may ask whether the user has preference (in his own experience) for any particular type of pump, the preferred material of construction and of packing for the pump gland, the type of drive which will be available, and the optimum speed based on existing power transmission arrangements at the works.

On his part, the prospective user of the pump may advantageously ask the maker for particulars as to ease of servicing, adjusting, and interchanging pump parts what safety features are incorporated into the design, and whether spare parts will be available from stock. These are points which arise in the final matter of making a decision, apart from the maker's guarantee as to performance, efficiency, and maintenance, the suitability of material of construction from pump maker's as well as pump user's viewpoint, and the initial cost.

### Materials of Construction

The material of construction for the pump has to be considered carefully in the light of experience, and possibly of fresh tests, where highly corrosive liquids have to be handled; it must be considered still further if any abrasive solids are involved. Here it is that the prospective user of the pump can greatly assist the pump maker, for a slurry which has to be handled may be one of which there has been no widespread experience. Moreover, the use of a particular metal or alloy may be objectionable from risk of contaminating the product, or of poisoning a process, or even of inducing catalytic action. The pump maker has the responsibility of supplying equipment that will perform its mechanical duty as well as its hydraulic duty, and he must remember this when the material called for may not be quite suitable for the construction of the pump and for trustworthiness of performance. This is one distinct point where co-operation between user and maker of pumping machinery is absolutely essential.

Against corrosive effects which arise from sulphuric, nitric, hydrochloric, acetic, phosphoric, and other commonly used acids, there is a wide range of materials which can be considered, but when actual conditions of concentration and temperature, with possible impurity, are stated it is quickly found that the number of permissible materials is appreciably smaller. For instance, if it is desired to pump sulphuric acid containng copper sulphate, as in the case of waste acid from a metal pickling process, there may be far fewer materials which prove satisfactory as compared with the number available for sulphuric acid of the same strength but without the impurity; but, in another direction, it may prove possible to use additional materials on which the copper sulphate exerts an inhibiting effect in respect of the action of sulphuric acid. Also

it may be desired to use the pump for cold and hot acid alternately, a condition of service which rules out the use of certain materials unable to stand up to sudden change of temperature.

As to type of pump, there is the choice of centrifugal, reciprocating, and rotary operation, with an ultimate choice of many individual patterns. The centrifugal pump may be the common or standard type, with volute or with diffuser, in either single stage or multi-stage; peripheral turbine; screw impeller; or propeller type. Rotary pumps include gear, screw, vane, and cam types. Reciprocating pumps may be power-driven or steam-driven, in both cases either simplex or duplex. The individual fields of application overlap, and this is where experience may dictate the ultimate choice. Where steam is available, and the exhaust can be used for heating, a steam-driven reciprocating pump may be used advantageously over centrifugal or rotary types. The centrifugal pump, however, is generally suitable for all service. Rotary pumps are used mainly where viscous liquids have to be moved. Both reciprocating and rotary pumps are more efficient for small capacities and relatively high pressures, but can be costly if it is necessary to make them in some special material; limits of physical property for some non-corrosive materials prevent usage.

The centrifugal pump is adaptable to standard motor speeds, it has low maintenance cost, and the discharge is continuous and free from pulsation. As another advantage the discharge valve may be shut off without building up dangerous pressure or causing increase in horse-power requirements. In addition, it does not occupy as much space or require a foundation as heavy as for the other types. Where it can be installed with liquid flowing to it, the centrifugal pump is usually preferable on account of its simpler construction, its lower cost, and its greater adaptability for use. The chief drawback is that it is not normally self-priming (although self-priming centrifugal pumps in certain sizes are obtainable), and where the liquid or slurry does not flow to the pump facilities for priming must be provided.

In construction the centrifugal pump has a rotating impeller, which is mounted on a shaft and rotates in bearings that form part of the pump casing. The volute type

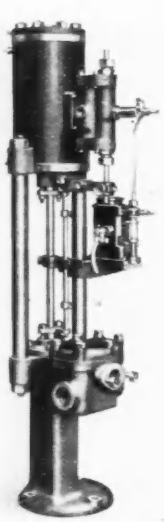


**Fig. 1 (left). Standard boiler feed pump, by Royles, Ltd. Fig. 2 (right). 2½" Rubber-lined glandless pump, by R. O. Stokes & Co., Ltd.**

(which is the common construction) has a progressively expanding annular casing at the periphery of the impeller; its one disadvantage is a certain amount of turbulence owing to change of direction in the flow of the liquid as velocity head is converted to pressure head. The diffuser vane type, sometimes spoken of as a turbine pump, gives higher efficiency as the internal construction with multiple expanding passages all round the periphery of the impeller more completely and smoothly converts the velocity head to pressure head.

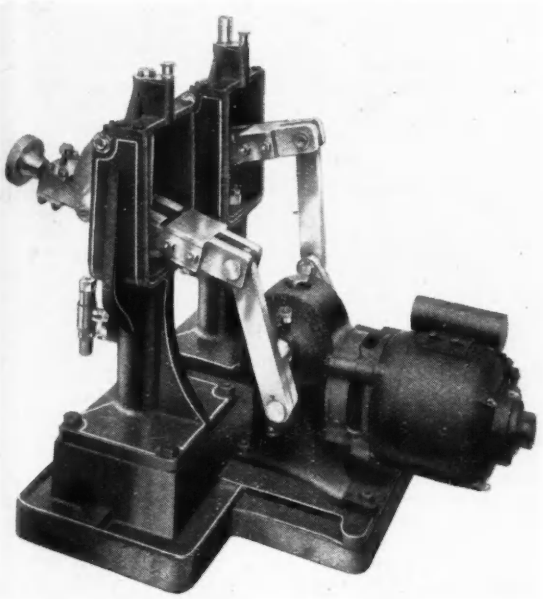
Impellers vary in construction from the simple open type, through single and double suction, to what is still more scientifically designed for low heads and large capacities, and is known as the axial flow type. Bearings for the impeller shaft can be babbitted, ball or thrust. A shaft sleeve protects the shaft from contact with the liquid which is being pumped, and also against wear by packing in the gland. The gland packing is usually in the form of rings of square cross-section, the number needed depending on the depth of the gland space. It is advantageous to have a deep gland space for preventing leakage of liquid from the pump and to prevent access of air which would interfere with the proper operation of the pump. With a deep space it is not necessary to pack so tightly as otherwise, thus decreasing possible wear on the shaft sleeves.

## Centrifugal Pump Types

Because of its simple design the centrifugal pump lends itself well to construction in various materials, as dictated by the nature of the liquid or slurry. Hard rubber and rubber lining, as well as metals and alloys, are used. A pump lined with soft rubber is advantageous for liquids carrying abrasive matter. Chemical stoneware is a good material for corrosive liquids, all parts of the pump which come in contact with liquid being made of stoneware, the stoneware shell itself being reinforced and protected externally by a cast-iron outer casing. Impellers of non-clogging type are made to handle slurries containing a high proportion of solids. It is common practice to combine pump and motor into a close-coupled unit, with the pump assembled at the end of an extended shaft on the motor; this arrangement saves space and requires the minimum of attention in checking alignment, and with ball bearings pump and motor can be installed either horizontally or vertically.

In the double-suction, as opposed to single suction type of centrifugal pump, liquid from the suction line divides into two parts and enters the impeller from both sides, so that theoretically there is hydraulic balance. Where the head requirements cannot be accomplished in a single stage, it is necessary to use two or more stages; multi-stage pumps give the combined effect of connecting up two or more single-stage pumps for the combined effect of the higher discharge pressure desired.

Rotary pumps are most useful for moving thick viscous liquids which are ordinarily difficult to handle with other types of pump. With close mechanical clearance between the rotating members they are most efficient when the liquids have lubricating qualities, but they can be used with non-lubricating liquids because they are self priming. For use with lubricating liquids the pump has internal bearings; with non-lubricating liquids there must be external bearings. In the common gear type there is a cycloidal-shaped casing with two spur gears, one driving and the other driven. The pumping action is positive; the gear teeth carry the liquid in slugs or small portions around the inner surface of the cycloidal casing, from suction to discharge side. Loss at the ends of the teeth and over the top of the gears is negligible, and there is delivery at a uniform pressure without shock or vibration. Such pumps can be used at much higher speed, if equipped with herring-bone gears, than with spur gear. In the screw type there are two screws which meet to form a liquid-tight seal and run with the minimum of clearance in their casing; liquid flows into the screws at the suction end where it is trapped and carried forward to the discharge end as the screw turns, very like the operation of a screw conveyor. All rotary pumps are of the positive discharge type; unlike a centrifugal pump, they cannot be operated against a closed discharge. Where this may occur, a relief valve has to be provided to by-pass the discharge back to the suction, otherwise pressure would build up until the pump failed or the motor became



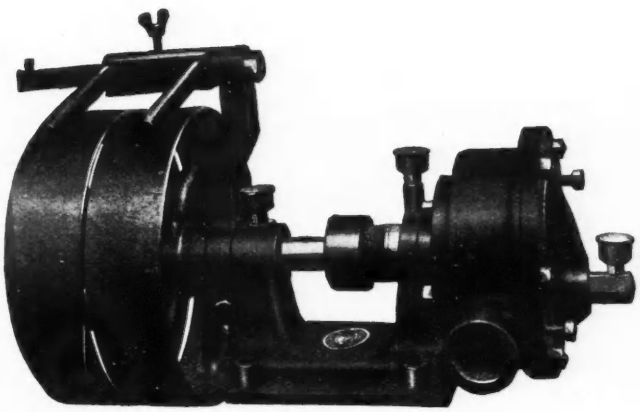


**Fig. 3 (left). Dual proportioning pump, manufactured by Hayward-Tyler & Co., Ltd. Fig. 4 (above). Concentric rotary pump, made by William Douglas & Sons, Ltd.**

overloaded. From the constructions outlined it will be seen that the use of rotary pumps is not practicable for liquid carrying grit or abrasive particles. Steam-jacketed rotary pumps are advantageous for heavy viscous liquids which are semi-solid at ordinary temperatures, *e.g.*, tar and molasses.

Reciprocating pumps may be of the plunger type (where the plunger moves past stationary packing) or of the piston type (where the piston carries its packing with it). They can be steam-driven or motor-driven. The direct-acting steam-driven reciprocating pump has the liquid end directly in line with the steam end, liquid piston and steam piston being operated together, independently of any crank movement. The simplex pattern has one steam cylinder and one liquid cylinder; the duplex pattern has two of each. The power-driven reciprocating pump, in vertical or horizontal design, has a liquid end which is practically the same as that of the steam-driven pump. All reciprocating pumps are self-priming, and can deliver at constant capacity against widely varying heads. For corrosion-resistance the liquid end can be lined with hard rubber or made of chemical stoneware.

For moving liquids with large amounts of suspended solids, and working against a head of only a few feet, a diaphragm pump of simple suction pattern is very suitable. The stroke of the diaphragm, and therefore its rate of discharge, can be controlled accurately by means of an adjustable eccentric which connects the respective shafts for the diaphragm yoke and the drive. If it is desired to obtain greater head, and also in the case of thick pulp and sludge, a pressure diaphragm pattern can be used; here the discharge valve is placed in a line emerging from the lower suction chamber below the diaphragm, and not in the diaphragm itself.

Pumps are kept in perfect working order, at least cost, by inspecting them at regular intervals to detect wear, corrosion, and other causes of failure, in advance of the event. If inspection is not frequent enough, failure may come at the most inconvenient moment, with the consequent necessity for make-shift repair, perhaps owing to the impossibility of shutting-down any longer than is absolutely necessary. When need of attention is indicated well in advance of possible failure, the pump can be shut-down at a convenient time (without affecting production) and a proper repair job can be done at minimum cost in skilled labour.

Inspection of pumps, as distinct from other chemical plant, should be "visual," and at less frequent intervals "internal." The visual inspection, while the pump is running, requires the service of a mechanic who is well acquainted with the construction and operation of pumps, and able to diagnose symptoms of trouble ahead; he checks the gland adjustment, bearing temperature, state of lubrication, motor temperature, and similar external features. For the internal inspection, which should be scheduled to avoid interference with production, there is an actual shut-down period during which the pump can be dismantled to the extent needed for a conscientious examination of the internal parts. This work may be done *in situ*, or there may be need for temporary removal to a more convenient position.

Gland maintenance is the most important feature in the care of a centrifugal pump handling corrosive liquid. As a direct result of experience it will be found generally that a definite schedule can be drawn up for re-packing the gland. With such a schedule the cost of gland maintenance is reduced to the minimum, production (depending upon service from the pump) is not hindered, and poor workmanship and poor materials are quickly detected. Likewise, poor supervision of the pump in operation can be under suspicion from the untimely failure of packing in the absence of other abnormal conditions.

## Factors in Repair Costs

The total cost of pump repairs largely depends on skilled operation of the pump, or at least upon adequate knowledge as to what a pump will stand in use and abuse. No amount of attention from the maintenance man can outweigh the effects of ill-use. To start up a pump when solution has been allowed to crystallise in the casing is an easy way of damaging the impeller. If water (from a hose) is allowed to get into ring-oiled bearings, it will not be long before the bearings show signs of seizing. Carelessness in tightening the gland will result in a damaged gland sleeve, and consequent leakage at the gland as well as seizing. A burned-out motor may be the result of putting heavier fuses in the power circuit when the correct fuses are constantly blowing—owing to some cause that should be investigated. Pumps may be stoutly built for the work which they have to do, but they do not stand treatment which is ill-fitted to their construction and mode of operation. In every case of failure it is wise to determine why the failure occurred and just how a repetition may be prevented.

The frequency with which it becomes necessary to repack the gland can be reduced by preventing overheating, which causes the packing to become dry; at the same time, wear on the gland sleeve will be reduced to the minimum. In some cases it may be necessary to allow a small jet of water to play on the gland; in other cases, a double gland can be used with water supplied under pressure at the

grease connection. The double gland arrangement, with water connection, is useful on self-priming pumps where admission of air at the gland is objectionable. When the pump is handling a liquid that does not allow the use of water, *e.g.*, strong sulphuric acid, the double gland can be fitted with a spring-loaded grease cup to supply a trickle of heavy oil.

Strain from pipe connections has to be avoided with small centrifugal pumps, and with those made of hard lead or high silicon iron; also in the case of chemical stoneware. Such pumps are unable to stand much strain without bearings and gland being thrown out of alignment; there will be a continuous sequence of troubles in the gland sleeve or the bearings, as when sagging of supports or foundation settlement takes place. To avoid undue strain it is useful to insert a short length of reinforced suction-type rubber hose, with flanged connections, between the pump and rigid pipelines on both suction and delivery sides.

The use of a strainer becomes vitally important where pumps are made of high silicon iron or chemical stoneware; but a strainer should always be installed when suction is drawn from a point where foreign fragments can get in and pass on to cause damage to the interior of the pump. Baseplates for pumps should be protected with sheet lead, especially where corrosive liquids are handled, for the reason that gland leakage may not be carried off adequately by the drip-cups provided; some solutions show a tendency to crystallise and choke the drain from the drip-cup. It is when the drip-cup ceases to function properly that the baseplate gets the drip; the subsequent corrosion gives a weak spot and in due course there is fracture, followed by strain and a broken impeller—which is more costly.

For the continuous feeding of filter presses it is often preferable to use the steam-driven reciprocating pump. In this service the centrifugal pump can be objectionable in breaking up the crystals in a slurry, with the result that the smaller-sized crystals produced prove difficult to wash for the removal of adhering mother liquor. The agitation received in its passage through a centrifugal pump can substantially increase the filtering rate for finely precipitated products, especially when a continuous filter is in use and the overflow passes repeatedly through the pump. Caution is called for in handling high density liquids at high heads with a centrifugal pump made of brittle material, such as high silicon iron, because the conditions may require the use of a motor with a starting torque nearly approaching the permissible limit for the pump. The use of a friction-drive coupling reduces the risk of injury to the pump, as this allows the gradual loading of the motor.

## A CHEMIST'S BOOKSHELF

THE CHEMICAL ASPECTS OF LIGHT. By E. J. Bowen. London: Oxford University Press (Humphrey Milford). Pp. 191. 12s. 6d.

The modern chemist who is not mathematically minded finds increasing embarrassment from the penetration of mathematics into his less abstract science. This book should enable many such readers to obtain a sound grasp of one branch of sub-atomic phenomena which has many practical ramifications. Designed primarily for students, but by no means limited to them in its appeal, the work interprets non-mathematically the theories of light which have immediate importance for the chemist.

Following a broad review of the nature of light, the classical branches of the emission and absorption of light are treated in the spirit of modern theory. This leads logically to a discussion of the reappearance of absorbed light as fluorescent, phosphorescent, or Raman radiation. Photochemistry is covered by a general review and a briefer chapter on vital syntheses, as well as by a consideration of the phenomena involved in photography. A short chapter on the reactions of the eye to light is particularly interesting because of the topicality of its subject; and the nature and behaviour of photo-cells are described. A final chapter on chemiluminescence rounds off a survey which, necessarily brief, yet lacks neither interest nor clarity.

The author cannot be blamed for the occasional over-condensation, which results rather from the restrictions imposed by the breadth of his subject and the limited space. Those chemists whose tendency is to turn hastily a page containing any symbol from the calculus should give this book a warm welcome.

BRITISH PLASTICS YEAR BOOK, 1942. London: Plastics Press, Ltd. Pp. 464. 15s.

Paper restrictions have naturally limited the extent of this new edition, but nevertheless the Year Book continues to be invaluable to the plastics industry. All the usual useful information concerning plant, proprietary names, associations, materials, etc., is again to be found in the volume, and the editorial section contains interesting articles on phenol-formaldehyde resins, cellulose acetate, recent ethenoid resin patents, and a review of nylon patents.

In a new booklet published by STERNOL, LTD., of Grey Timbers, Westerham Road, Limpsfield, Surrey, entitled "Industrial Dermatitis—its cause and prevention," much interesting information is given regarding the disease itself, its treatment and prevention.

# Synthetic Rubber Research

### Inflammability of Acrylonitrile

THE limits of inflammability of combustibles are not only of theoretical, but also of practical importance, because many chemical industries have sooner or later to contend with explosive mixtures of combustible gases or vapours in their manufacturing processes. Many new organic compounds, which a few years ago were laboratory curiosities, are now being manufactured, transported, and used in huge quantities. The war in the Far East, by its interference with the supply of crude rubber, has drawn renewed attention to the manufacture of synthetic rubber, and the constituents entering into its manufacture have assumed new importance. A report, by Jones, Kennedy, and Scott, of the U.S. Bureau of Mines (R.I. 3597) on the Limits of Inflammability of Acrylonitrile in Air is therefore specially apposite to-day.

Acrylonitrile is a liquid used in large quantities in one of the synthetic rubber processes. It offers some experimental difficulty because it is unstable at elevated temperatures, is reported to be highly toxic, and has a limited range of vapour pressures at laboratory temperatures. Further, because of the difficulty of preparing and analysing acrylonitrile-air mixtures by the usual methods of gas analysis, it was necessary to employ equipment (illustrated in the report) especially suited for this investigation. After careful experiment it was demonstrated that acrylonitrile may produce inflammable mixtures in contact with air within the temperature range of −6.25 and +29.4° C. at a barometric pressure of 745 to 750 mm. Hg. Above 29.4° C., if air is saturated with acrylonitrile vapour, the mixtures contain so much combustible vapour that flame will not propagate. The lower limit of its inflammability in air at laboratory temperatures and pressures is 3.05 per cent. by volume. The vapour pressure of acrylonitrile is insufficient to give upper-limit mixtures at laboratory temperatures (20° to 27° C.); therefore the upper limit of inflammability was obtained by determining the highest temperature at which air saturated with acrylonitrile vapour gave mixtures that propagated flame, and by calculating from data on the vapour pressure of acrylonitrile at this temperature and the barometric pressure at the time. The upper limit of inflammability of acrylonitrile in air at 29.4° C. and 747.5 mm. Hg pressure was 17.0 ± 0.5 per cent. by volume.

# From a Works Maintenance Notebook

AT chemical works the need for maintenance starts as soon as plant or equipment is put into service. Mechanical wear and tear, which exists wherever there is moving machinery, provides but one aspect; there is also the corrosional influence of chemicals (even when merely in storage in a tank), leakage from pipe-joints and valves, and the detrimental effects of a fume-laden atmosphere as regards buildings. Moreover, it does not suffice to be aware of these facts and to put matters right when the need arises. Deterioration in chemical plant has the characteristic of developing with varying intensity and the effects can be undetected until they have reached a stage when failure of the particular plant part (and perhaps the plant unit as a whole) must be the result.

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In the absence of good maintenance, chemical plant has a way of failing at the most unfortunate moment; perhaps during a night shift when there is the minimum of staff available to deal with the trouble, or when production pressure has been temporarily increased to meet urgent orders. The plant part concerned may be sufficiently vital to put the plant unit completely out of operation, with movement of product at a standstill until repairs have been effected. Much chemical plant features as one unit in a sequence of operations which make up a complete process of manufacture, and efficiency and smooth working depend on the functioning of each unit at some pre-arranged capacity without hindrance. Temporary accumulations of product at various stages in manufacture may be tolerated in the case of certain mass-produced goods (even if there is momentary inconvenience), but this is not so in the case of chemical products, where interacting quantities and standards of purity or concentration must be kept to certain levels for the process as a whole to run according to plan. The breakdown of a plant unit for the early stages of processing (as with a crusher) may force the rest of the plant to stand idle, so that production is completely blocked. The failure of some intermediate feature may mean that only part of the plant has to remain out of action while repairs are effected; with other parts of the plant still capable of operation, there is then need to provide intermediate storage as a temporary measure, or to slow down or speed up operations in one direction or another, all with bad result on the routine and interdependence of processes at the works. Resulting increased costs in the matter of production may prove quite serious when they have been worked out.

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To be effective, maintenance at chemical works should be the work of one or more of the personnel in particular. In any case there must be one person responsible for seeing that it receives attention, with others (in number according to needs) to carry out the routine of inspection and service, each fitted to the jobs which particular skill dictates. In each sphere of attention, inspection follows a pre-arranged schedule from corner to corner throughout the works, matters requiring attention being put right *en route,* as it might be said. Electrical equipment, for instance, must be continuously under observation, to guard against damage to motors, the hazard of personal injury, or the risk of mere failure. Pumps and fans have to be kept at their highest efficiency to prevent fluctuations in the movement of liquids and gases; pipework must be kept free from leaks at the joints; cocks and valves must be ready to operate with ease at any moment determined in course of the process or at demand of unexpected emergency.

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A valve which shows any tendency to be difficult to close or open is a danger to plant where it is fitted; a valve which suddenly "sticks" and defies operation is a menace to the safety of the works and its personnel generally, and someone should be answerable. Even when there is no immediate danger (by virtue of conditions existing), there may still be hindrance to the course of a process, and this can prove expensive as regards delay in execution of orders or wastage of material under treatment.

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Apart from inspection and repair service there is another aspect of maintenance which should receive attention, because it aids the efficiency with which maintenance generally is carried out; this is the keeping of a record of inspection, with note of matters which required attention. From such a record, accumulating month by month, it is possible to determine more closely the frequency at which inspection—for plant unit or plant parts individually—is desirable, and to decide what spares shall be in the plant store. Each machine, as soon as it it fitted into the order of things at the works, should have its maintenance record sheet on file, duly entered with the preliminary particulars of description, source of supply, order reference, date when supplied, date when put into service, and the desirable frequency of inspection. From the entries which are subsequently made (fitter's time as well as material parts) it is possible to determine maintenance costs at any date or covering any period.

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Low cost of maintenance is determined by the use of proper materials of construction. Any increase in first cost due to the selection of a particular material, which experience indicates, will be duly absorbed in the greater economy of operation achieved in a plant unit for which the cost is relatively high, as with an evaporator or a rotary vacuum filter. The use of other material, suggested by some advantage in cost, may prove to be the cause of high operating costs from the frequency with which it may be necessary to "shut-down" for repairs. That is why it is wise to keep this matter of maintenance cost in view when buying new plant, and to profit where possible by the experience which plant makers may be able to offer. A cast-lead construction may be desirable for a rotary vacuum filter; rubber-lined steel may be indicated for a vacuum crystalliser which is to handle acid liquors; solid nickel heating elements may be needed for contact with caustic soda under evaporation.

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For moving machinery, lubrication in maintenance has to be regarded as something more than the mere application of grease or oil. Each type of plant has its own lubrication problems, especially plant that has been designed for large output or where exceptional conditions exist as regards load, shock, or temperature. Where severe abrasion or shock is involved, the life of plant can be extended considerably by using lubricants which have had their load-bearing properties increased by treatment at the hands of the lubricant manufacturers. Special products are obtainable to give low change of viscosity with temperature variation, exceptional stability, or resistance to foaming. The cost of a special lubricating medium may be high, but this extra cost may be offset in the consequent reduced cost of maintenance.

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Plant maintenance, it is true, often appears in the light of one long round of monotonous and seemingly unimportant routine tasks. If routine inspection is allowed to become haphazard, the task of working the plant smoothly will develop into something which may be costly, irritating, or continuously unpleasant from fear of breakdown as one small thing after another comes to light. Employees allocated to maintenance work should not only be skilled in their respective spheres, but must also be conscientious and take an interest in their duties. Monotony can be overcome by giving careful attention to the schedule of duties as regards inspection, with the use of an intelligent form of record sheet. Ease of access to the various plant parts makes for general convenience in inspection, replacements, and effecting repairs.

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The plates and frames of a filter press would last

indefinitely if it were not for breakage due to uneven pressure from a clogged port or to careless handling. Normally, the only replacement is the filter material, but here, too, it must be emphasised that damage to filter cloth comes more from carelessness in removing the cake than from any other cause. In spite of its sturdy construction, the plates and frames of a filter press have to be kept in the best possible condition, both in use and when idle, if the press is to work efficiently. When not in use the plates and frames must be kept clean and dry. Cast iron can be protected against rust and consequent contamination of filtrate and filter cake by a coating of some suitable lacquer which is unaffected by the product to be filtered. Wood has its own peculiar susceptibility to temperature and humidity changes, with possible shrinking, swelling, or warping, and this calls for attention to a wooden filter press which is standing idle. Such a press should be kept tightly closed and full of water, spare plates and frames being placed in a tank of water where they are kept immersed by weights, or, better still, in a screw press, in order to avoid warping. Wood plates and frames will last longer if yellow pine is selected for cold or slightly warm solutions, and maple for hot solutions. Rubber plates and frames should not be used at temperatures or at pressures as high as those permissible for either wood or metal.

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Vibration which is transmitted from the floor or walls of a building may become a source of danger to chemical stoneware equipment. In situations where excessive vibration is likely to occur it is advisable to counteract it by the use of pads of rubber or other resilient material. Large towers may be carried on a bed of sand which is prevented from spreading by brick or concrete retaining walls; smaller vessels, such as stoneware vacuum filters, will better resist the ill-effects of bad vibration if there is asphalt or jointless-composition flooring. In the case of towers, it is equally important that the base be adequately solid and rigid to prevent any settlement, which can cause fracture of one of the sections due to the resulting unevenness in distribution of load for a tower with its internal packing. Tower foundations must be protected against the deleterious effects of dripping acid. Protection should also be given against wind pressure, if this is likely to be severe. Up to a height of about 18 feet, a tower of appropriate diameter will carry its own weight, but for a greater height there should be external support under the bell at each alternate section.

* * *

Electric motor failure can be reduced by the wider use of totally-enclosed motors. At chemical works, in particular, the most frequent cause of failure for open-type motors has been water or corrosive chemicals reaching the windings. When totally-enclosed motors have failed in similar situations it has generally been found that failure was from some such cause as bearing trouble, faulty coil connection, or water which had entered the inner frame by way of non-watertight connection boxes. Apart from the value of a totally-enclosed motor in the possible presence of inflammable vapours, the mere proximity of open tanks into which liquid is being pumped and the use of hose for washing floors should be sufficient to urge the use of this type of motor wherever possible at chemical works. The study of motor maintenance records will convince those who think the higher initial cost is not justified.

* * *

Where a grinding mill is likely to stand idle for a long time, it is well to remove the balls or pebbles and thoroughly clean the interior of the mill. Bearings, gears, and pinions should also be cleaned and have a fresh application of oil and grease. Frequent inspection of the lining of ball and pebble mills is necessary during use if serious damage to the mill shell is to be avoided. Occasional tightening of the lining bolts will prevent breakage of the liners. During inspection care should be taken that gears and pinions are properly aligned and that pinion teeth do not "touch bottom." Proper lubrication of gears and pinions with a recommended lubricant is not sufficient; the parts must be kept free of dust, and if the mill is working in a particularly dust-laden atmosphere, devices must be installed to prevent the undue deposition of dust on mechanical parts. In the case of main bearings it is absolutely essential to keep out dust; a trunnion which becomes scored is a much more serious matter as regards repair than the re-babbitting of a main or counter-shaft bearing.

* * *

Maintenance of electrical recording instruments is a matter which is best left in the hands of the makers, unless the number of instruments at the works is sufficient to keep a man who has the necessary skill to attend to them. In other circumstances the makers will usually provide the needful service for a yearly fee, and this fee is a sound investment for maintaining the accuracy of instruments.

# Calcium Metal Production

## A New American Industry

THE Union Carbide Company, an important producer of calcium carbide, and its associated company, the Electro Metallurgical Company, have long been interested in the possibilities of calcium metal, and its production and use have been the subject of much investigation, which has resulted in several novel methods of producing calcium, as well as a good deal of information pertinent to the standard electrolytic process. As the U.S.A. was completely dependent upon France for the supply of calcium metal, the companies decided to proceed with an industrial plant to produce this metal at Sault Ste. Marie, Michigan, and this is now in full production.

The electrolysis of calcium chloride is one of the most difficult of all electrolytic operations; the process is not so much the production of calcium metal in the cell, as the chloride seems to obey fundamental laws and liberate calcium in accordance therewith, but rather the collection of that calcium, as calcium reacts readily at elevated temperatures with practically all the elements except the inert gases. The need for extremely close control is emphasised by the fact that the melting point of calcium, about 810° C., is only 38° above that of calcium chloride. The calcium is deposited in the molten state, but is collected in the solid state by continuous deposition and freezing on the cathode, the motion of which is adjusted so as to remove calcium from the bath at exactly the rate of its deposition. The problem is further complicated by the generation of chlorine at the anode and the need to keep this chlorine away from the cathode. Maintenance of a barrier between anode and cathode to prevent chlorine collecting at the cathode is another problem. A radical change in cell design, consisting mainly in using much larger cells than customary contributed to economic production. The supply of imported calcium, formerly amounting to about 42,000 lb. a year, has ceased, but accumulated stocks can now be expanded as the defence programme may require.

### Uses of Calcium Metal

Calcium metal has a variety of uses. Broadly it is used as a "deoxidising" nucleation or precipitation agent with non-ferrous metals; as a deoxidiser, desulphuriser, and scavenger of ferrous metals; as a reducing agent for the less easily reducible metals; and as an absorbent for oxygen, hydrogen nitrogen and other gases in strictly chemical processes. In the first category the most widespread use of calcium is with magnesium in additions up to 0.25 per cent., resulting in an improved surface on magnesium-base castings; it is likewise used for deoxidising aluminium and in maintaining lead in the emulsified state in high-lead copper-bearing alloys. Calcium in lead is of major interest in cable sheathing and for battery plates. Calcium as a deoxidant and as a final addition in steelmaking has long been of some importance, especially, nowadays, for the production of high-quality stainless steels.

# Review of the Year's Chemical Engineering

## Fuel Efficiency Committee's Work

by W. C. PECK, M.Sc., M.I.Chem.E., A.I.C.

ECONOMY in the use of fuel of all kinds is of the utmost importance at this period of increasing output of war materials. In consequence the Mines Department has recently brought into being a "Fuel Efficiency Committee" to inculcate economical methods of fuel usage. At a recent London meeting speakers who were aware that their fuel-using plants were still capable of some heat economy, instanced the difficulties in obtaining steel as the reason for the lack of the equipment necessary to obtain greater economics. The various methods of firing fuels, coal, pulverised coal, oil and gas, in tunnel kilns, are discussed by Brush.[1] Henley,[2] reviewing the present position of the gas producer for road transport, draws particular attention to increasing the reactivity of the coke used. Carr and Pullein[3] publish operating data of pulverised fuel boilers and point out the advantages of flexibility and wide choice of coal of this type of boiler. An important paper by Dornbrook[4] is worthy of attention. He suggests what may be a major principle in pulverised fuel boiler design. The development of such boilers is traced and a practical solution of the slagging problem is put forward. This solution is to design the furnace for such appreciable heat absorption that the hot gases are at about 110° below the softening temperature of the ash, when they enter the first row of boiler tubes. Extensive fuel bed tests at Hell Gate, U.S.A., generating station are reported by Mayers, Dargan, Gershberg, Dalway, Williams, and Kaiser.[5] An interesting description of bark-burning furnaces for the paper and pulp industry is given by Hulsart.[6]

### Heat Transmission

The heat transfer to falling water films in turbulent flow inside copper tubes has been examined by McAdams, Drew, and Bays.[7] The data obtained are represented by $L = 120W^{0.33}$, where W = 600–15,000 lb. of water per hour per foot width of stream. Steamside and overall coefficients are given and the data for streamline flow over horizontal tubes are reviewed. Cessna, Lientz, and Badger[8] publish the overall heat transfer coefficients for a long-tube vertical evaporator operating with non-boiling and boiling sucrose solutions and for water. The maximum temperature occurring during evaporation is of importance with certain heat-sensitive substances, and Cessna and Badger[9] have correlated a number of results to permit the prediction of the maximum temperature occurring in a long-tube vertical evaporator over a wide range of variables. McAdams, Woods, and Bryan[10] investigated heat-transfer coefficients during vaporisation inside a horizontal tube. At moderate temperature differences, vapour binding causes a drop in the coefficients. With higher temperature differences, the drop in the coefficients is attributed to the vapour film insulating the tube from the bulk of the liquid, such as is well known with boiling liquids outside submerged tubes. The advantages of heat transfer by organic fluids at high temperature are the subject of a paper by Lewis and Rudorff,[11] who give relevant data on vapour pressures, latent heats, and specific heats. Othmer and White[12] report film coefficients for a number of lower alcohols. Kämmerer[13] publishes some data on the calculation of heating surfaces, and shows some differences obtained in practice, from figures calculated from the heat-transfer coefficients and the logarithmic mean temperature differences. The provision of rotable baffles in a vertical-tube evaporator is proposed by Winhuisen[14] for frothing liquids.

Constructional details of plate heat exchangers still occupy the attention of many designers, including Mickelsen and Rebbeck,[15] Aluminium Plant and Vessel Co.,[16] E. S. Symonds,[17] and A/B Separator.[18] Special designs of this type of heat interchanger for air are described by Tillotson[19] and by Watkinson.[20]

The variation of inefficiency with temperature for different Reynold numbers is reported by Jacobs and Collins[21] in an experimental study of heat interchangers. The relationship between the size of the air preheater and the degree of waste heat recovery, based on test data for a Babcock and Wilcox type air heater is discussed by Rudorff.[22] In British Thomson Houston Co.[23] patent a number of louvres for controlling the air flow through air-cooled condensers and similar heat-exchange apparatus.

### Fluid Flow

Hatch[24] finds the equation for flow through granular media to be essentially identical with that for flow through pipes, when certain variables have been modified. Simplified equations and alignment charts for the determination of economic pipe-size for pumping of viscous and non-viscous liquids are given by Sarchet and Colburn.[25] The theory of fluid flow through porous media, in relation to data obtained by studying the flow of air through cotton, wool, rayon, and glass wool is discussed by Fowler and Hertel.[26] Hawkins, Solberg, and Potter,[27] examining the viscosity of superheated steam, suggest a modification of Planck's equation to express the results up to 1810 lb./sq. in. absolute and 538° C. Simplifications of the empirical equations for the velocity distribution of liquids in turbulent flow, previously put forward, are suggested by Jakab, Sherwood, Nutter, and Bates.[28] Montgomery[29] advocates the use of submersible pumps, designed for deep well pumping, for handling inflammable liquids. The flow of sludges in circular pipes, in turbulent flow, is shown to be similar to that of true liquids by Caldwell and Babbitt;[30] but that, below a critical velocity, flow is plastic and does not obey Poiseuille's equation. Hatch[31] in a paper on the design of exhaust duct systems, advocates the balancing of duct resistances, so that the use of dampers which reduce the efficiency, can be obviated.

Jennings[32] has obtained practical data from the operation of pneumatic conveying systems and applied them to the evaluation of constants in theoretically derived equations.

### Drying

Developments in drying plants are mainly connected with rotary types where the air is passed through perforated floors on which the material is supported. Thus Hayes and Nicoresti[33] patent an apparatus for drying by passing air through perforations in the walls through agitated materials; and Spooner[34] describes plant for drying by passing air through loose materials. Huse[35] patents a rotary drum dryer having shallow lifts and a stationary louvre guide device on which the material slides, and through which the heating gases enter. Proctor and Schwartz[36] patent improvements in the design of their fin drum dryers.

### Mass Transfer

Under this heading it is convenient to deal with Absorption and Distillation, for in both the operations the same equipment is used, and the same theoretical approach is adopted. In the former process, one deals with a dissolved gas, and in the latter, a dissolved liquid. Sherwood[37] has shown that the mathematical analysis of the analogies between the phenomena of mass transfer, heat transfer, and the frictional resistance to flow, indicates that the Kármán theory covers the greatest range of experimental data.

Bragg[38] describes a form of column packing for close fractionation and claims a better combination of operating characteristics and a greater number of theoretical plates per foot of height of column. The effect of column hold-up on batch distillation is discussed by Colburn and Stearns.[39] Gilliland[40] claims that by a suitable selection of functions to be plotted, the number of theoretical plates required for distillation can be correlated with the reflux ratio by an empirical curve. He shows that when the data

for sixteen specimen separations are plotted, the maximum deviation from the average curve is 7 per cent. of the number of theoretical plates. Colman and Schneible[41] patent a column for dust separation, absorption, and scrubbing, which is neither of the packed, nor of the bubble type. In this column the whole of the contents are kept in rotation by the tangential entry and exit of the main gaseous fluid, and also by the provision of curved vanes incorporated in the baffle design. Liquids, which flow downwards counter current to the gases, are fed centrally on to dome-shaped baffles and form liquid curtains whirling round the wall of the column. Horton and Franklin[42] suggest simplified equations for the design of absorbing or stripping columns, which involve appreciably less labour than plate-to-plate calculations.

## Extraction

Maloney and Schubert[43] propose a graphical method for the solution of solvent extraction problems, based on that used by Ponchon and by Savant, and the avoidance of triangular diagrams is achieved. A discussion of the battery system of diffusion and extraction is given by Sorgato.[44] Continuous counter current solvent extraction plants of the column type still attract attention. The Extracto Process, Ltd.,[45] patent one such plant consisting of a vertical column in which the solids pass downwards, and the solvent flows upwards. As the material approaches the discharge end, it is compressed and the hydrostatic pressure on each side of the compressed mass is equalised by having a column of solvent connected to the discharge end of the column, through which the extracted solid material has to pass before discharge. A liquid-liquid extraction column packed with saddles or rings was found by Row, Koffolt, and Withrow,[46] to be more efficient than perforated-plate or bubble-cap columns, but knitted cloth packings and spray columns were less so.

## Mixing, Crushing and Screening

For solid materials, the rotating pan type of mixer proves very efficient, as the vertical mixing is achieved more satisfactorily than in any other type of mixer. Eirich[47] patents, for example, for this type having a perforated centre for discharge, devices to change the perforated centre to suit continuous or batch working and also to alter the degree of grinding that can be carried out.

Some attention has been given to the determination of surface area. Kenrick[48] has devised a new method based on the theoretical consideration that the average projection area of a solid figure possessing no re-entrant angles in all random positions is a quarter of the area of the figure. Emmett and de Witt,[49] investigating the determination of surface area by the low temperature adsorption method using nitrogen, suggest that this method is capable of extension to industrial materials. Dealing with crushing plant, we find that the Hume and Hume Pipe Co. (Australia), Ltd.,[50] patent a crusher in which a concentric and an eccentric roller both revolve downward at the nip, with the crushing gap adjustable. "Accelerating units," or ejector devices consisting of angular jets of compressed air, are provided in an impact crusher by Myers,[51] to entrain the material flowing axially. Improvements are proposed in screening plant by F. Parker, Ltd., Parker and Thorne,[52] who patent devices by which tray screens are oscillated in opposite directions, so that a tray takes the place of the balancing deck.

## Filtration and Sedimentation

While the theory of filtration has become increasingly complex, many practical problems can only be solved by an empirical approach. Fedeler[53] proposes to vibrate the cake of thixotropic material on a rotary drum filter, when substantially horizontal on the crown of the drum. The vibrations are obtained by producing waves of increased and reduced pressure in the filtrate by means of a rotary valve. The characteristics and special applications of various filter media, glass cloth, vinyon fabric, multipore latex rubber, hard microporous rubber, and woven wire cloth, are described by van Antwerpen.[54]

In the unit process of sedimentation also, the theoretical approach is complex, and the many investigations reported in recent years have provided much material for consideration. Donald[55] has shown the important rôle played by flocculation in affecting the effective diameter of the particle while it is settling. Work and Kohler[56] examining suspensions of calcium carbonate and of basic aluminium sulphate precipitated on barium sulphate, found that there could be discerned in the falling rate a period of sedimentation, and that the sludge was at first fluid and then became plastic. Examining the settling characteristics of inorganic materials in air, Berkelhamer[57] reported the characteristics of various dusts obtained by a Leitz tyndallometer.

## High Vacua

Morse[58] discusses the use of various baffles, such as charcoal traps, cold traps, hot baffles, electrical and mechanical baffles, used with high vacuum pumps, to prevent back diffusion of oil vapour and to ensure that any oil vapour that does diffuse back is not saturated, and finds that low-temperature traps are not essential for modern oil-diffusion vacuum pumps. He suggests designs for high-speed baffles. For high-vacuum distillation apparatus Distillation Products, Inc.,[59] patent a design by which a distilling surface is rotated at centrifugal speed usually with a condensing surface, which is perforated so that the residual permanent gas can pass through more readily than the vapours. A series of concentric perforated condensing surfaces can be used to obtain fractional condensation.

For the construction of high pressure vessels I.G. Farben[60] propose banding an inner shell with spirally wound and longitudinally grooved and interlocking bands. The corrosion of magnesium condenser tubes is reported upon by Nagaoka, Watanabé, and Yoneyama.[61] Griffiths,[62] following his first notes[63] on practical conversion engineering calculations in which he discusses conversion of units and the importance between ratio and rate and between absolute and gravitational units, now emphasises the distinction between symbols representing numbers and those representing quantities, and further advocates the method of homogeneous units.


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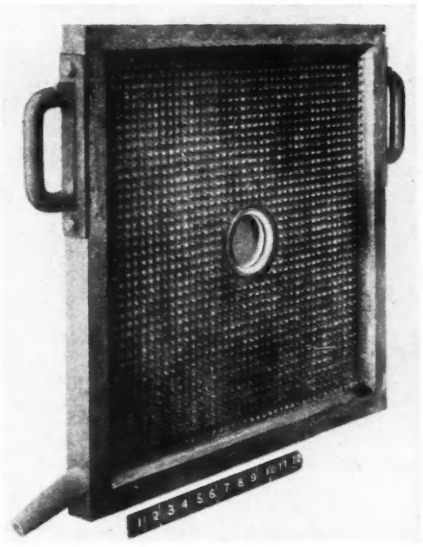
(*Continued at the foot of page* 144)

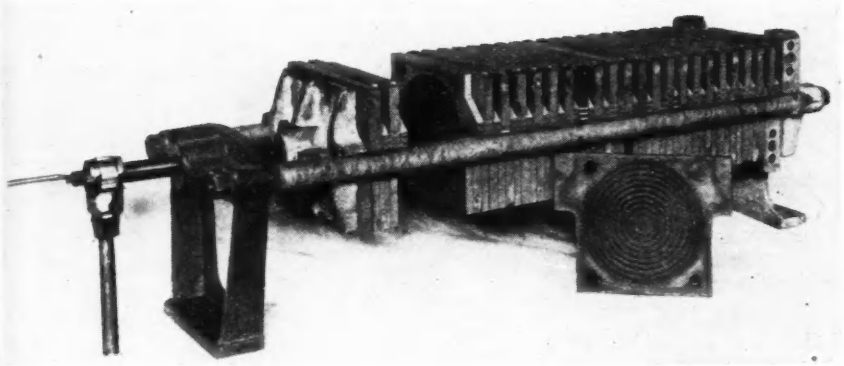
# Improved Filter Press Material

## "Keebush" Plates and Valves

FILTER press plates and frames are now made in "Keebush" material, an interesting new development of the Kestner Evaporator & Engineering Co., Ltd. In many filter press operations the presence of acidic and corrosive liquors is a source of constant trouble and the cause of expensive upkeep. While wooden plates and frames have generally been used in the past they cannot be regarded as satisfactory, splitting, warping, and deterioration of the wood being all too common. "Keebush" is non-absorbent, light in weight (density 1.6), and impervious to the attack of most corrosives including hydrochloric acid, chlorine and its compounds, sulphuric acid up to 50 per cent. conc., sulphurous acid, etc. Furthermore, it is not affected by temperatures up to 130° C. This material is, therefore, very suitable for use in filter press frames and plates.

In addition to filter plates and frames, "Keebush" valves and taps are being supplied for use with filter presses. The valves and taps cannot leak or drip as they are glandless and the closure is made by the depression of a special rubber diaphragm (Saunders Patent). Standard valves from ½ in. to 6 in. dia., flanged to B.S.T.D., are supplied for working pressure up to 50 lb. per sq. in. Taps with conical tapered ends for force fitting into existing press plates are also supplied, and these can be made with plain ends, bib ends, or ribbed ends for hose connection.





**On the left, a filter-press fitted with "Keebush" plates and frames. Above, an enlarged illustration of a filter plate**

# The Institute of Metals

### Annual General Meeting

THE 34th annual meeting of the Institute of Metals took place at 4 Grosvenor Gardens, London, S.W.1, on March 11, the chair being taken by the President, Lieut.-Colonel the Hon. R. M. Preston, D.S.O. In the Report of Council for 1941 it was noted that, in spite of the intensification of the war, the Institute's premises remained intact; its publications had continued to appear regularly if in somewhat diminished volume, for the reason that certain papers could not at present be made public); and its financial position had been strengthened so that when, with the coming of peace, the floodgates of metallurgical information were opened, there would be available sufficient funds to allow of the publication of this matter without involving the Institute in financial embarrassment. For this satisfactory state of affairs the Council was largely indebted to the firms who had so generously contributed to the Endowment Fund and to the War Emergency Fund.

The number of members at the end of the year was 2211, including members in enemy-occupied countries, whose names are carried on a "suspense" list until the end of the war. Since the last general meeting 25 ordinary members and 15 student members have been elected.

Officers elected for the year 1942-43 were: President, Lieut.-Colonel Sir John Greenly, K.C.M.G., C.B.E., M.A.; vice-presidents, Messrs. Horace W. Clarke and H. S. Tasker, B.A.; members of council, Messrs. G. Wesley Austin, O.B.E., M.Sc., W. F. Brazener, and H. W. G. Hignett, B.Sc.

The president presented the platinum medal for the year 1942 to Mr. W. Murray Morrison, deputy chairman and managing director of the British Aluminium Co., Ltd., the medal having again been offered to the Council for award by the Mond Nickel Co., Ltd.

It was announced that the 1942 May lecture is to be given to the Institute by Mr. W. T. Halcrow, M.Inst.C.E., at 6 p.m., on May 13, at the Institution of Mechanical Engineers, Storey's Gate, S.W.1. The subject of the lecture is "Water Power and its Application to the Production of Metals." Visitors' tickets can be obtained from the Secretary of the Institute of Metals, 4 Grosvenor Gardens, London, S.W.1. Applications for tickets to be sent by post should be accompanied by a stamped addressed envelope.

# Personal Notes

MR. H. L. JOHNSON has been nominated for election as president of the Textile Institute for 1942-43 in succession to MR. G. H. THOMPSON. MESSRS. W. KERSHAW, W. W. L. LISHMAN, and W. H. WEBB have been nominated for re-election as vice-presidents.

LIEUT.-COL. SIR JOHN HENRY MAITLAND GREENLY, K.C.M.G., C.B.E., M.A., M.I.Mech.E., M.I.E.I., F.Inst.F., has been elected President of the Institute of Metals for 1942. He has always been associated closely with the non-ferrous metals industry, and was Chairman of the British Non-Ferrous Metals Research Association in 1937 and President of the Institute of Fuel in 1938-41. He was a member of Council of the British Coal Utilisation Research Association and has served on the Council of the Institute of Metals since 1936. For his work as member of the Industrial Advisory Panel to the Air Ministry and Chairman of the Prime Minister's Advisory Panel of Industrialists on Rearmament (1938-39) and Controller-General of the British Supply Board in Canada and the U.S.A. (1939-40) he was created K.C.M.G. in the New Year's Honours List of 1941.

MR. W. MURRAY MORRISON, M.Inst.C.E., M.I.E.E., F.Inst.Met., who has been awarded the Platinum Medal of the Institute of Metals for 1942, may fairly be described as the father of the aluminium industry in Britain, having been associated with the British Aluminium Co. from its inception in 1894, and responsible for the development here of the Hall-Héroult electrolytic process. Mr. Morrison was the company's first engineer, and was appointed manager of the Foyers Works when they were constructed in 1895 to utilise the water power from the Falls of Foyers, in his native county of Inverness. On the death of Lord Kelvin he became sole technical adviser to the company; in 1910 he was appointed general manager and he joined the board in 1927. Three years later he became managing director, and in 1934 deputy-chairman, which two positions he holds to-day. Mr. Morrison is an original member and a Fellow of the Institute of Metals, on the council of which he served for 16 years—for the last two as vice-president.

## Obituary

MR. FRANCIS JAMES SELBY, C.B.E., M.A., who died at Teddington, Middlesex, on March 5, aged 74, had been Secretary of the National Physical Laboratory from 1918 to 1932, and had previously served on the staff of the Laboratory since 1903.

MR. JOHN HENRY SIMCOCK, who died at Bury, Lancs., on March 2, was a director of Crystal and Co., manufacturing chemists, of Rochdale, and an old member of the Manchester Royal Exchange. He had been a director of Crystal and Co. for six years, having been elected to the board after ten years' service on the sales staff.

# New Control Orders

## Essential Work

The Essential Work (General Provisions) Order, 1942 (S.R. and O. 1942, No. 371) which came into force on March 9, applies to all factories, etc., engaged in work essential to the defence of the realm, and revises the Order of the same title made in 1941.

It renews the provision that an employer in an essential undertaking shall not terminate (except for serious misconduct) the employment of any specified employee without permission of a national service officer, and that such an employee shall not leave his employment without such permission.

In any case of an illegal strike, however, a worker who has not participated in the stoppage and for whom no work can be provided, can be given four days' notice that his guaranteed wage will be suspended. He must, however, be reinstated as soon as employment is available. During this period of enforced idleness without pay the worker, after giving any notice required by his contract, can leave the factory without permission from the national service officer. If the worker fails to present himself when an offer of reinstatement is made, his employment is to be regarded as terminated.

If any worker absents himself from work without reasonable excuse, or is persistently late, or fails to comply with any reasonable orders, the employer may report in writing such matters to a national service officer. The officer shall communicate the particulars to the worker who is the subject of such report and if he is satisfied of the truth of the matters so reported, he may give directions to that worker to perform his work. If the worker to whom the national service officer has given such direction so requests in writing within seven days of the date of the giving of the directions, or within a longer period if the case demands it, he can appeal to the Local Appeal Board. Reinstatement of a worker at the direction of a national service officer will carry with it retrospective payment of his guaranteed wage during the time he was stood off.

## Export of Acetates, Iron and Steel, Rubber and Iodine

UNDER the Export of Goods (Control) (No. 10) Order (S.R. & O. 1942, No. 353), which becomes operative on March 24, control is extended to cover the export to all destinations of lead acetate, sodium acetate and internal combustion engines (and parts), hair combs made of non-precious metal, machinery belts and belting (including conveyor and elevator bands) wholly or partly of natural or synthetic rubber. The control in respect of rubber latex is extended to cover manufactures wholly or mainly of this material.

Licences will in future be required to export synthetic rubber (all types) and manufactures wholly or mainly thereof; and iodine compounds and preparations containing iodine or iodine compounds not specified elsewhere in the Schedule of Controlled Goods.

## Exemption from Key Industry Duty

The Safeguarding of Industries (Exemption) No. 1 Order, 1942, which is effective from March 11 until June 30 this year, exempts quinolinic acid and succinic acid from Key Industry Duty.

(Continued from page 142)


32 *Engineering*, 1940, *150*, 361; B.C.A., B.I., 1941, 46.
33 B.P. 526535; B.C.A., B.I., 1941, 5.
34 B.P. 526346; B.C.A., B.I., 1941, 5.
35 U.S.P. 2119916; B.C.A., B.I., 1941, 313.
36 B.P. 535505; B.C.A., B.I., 1941, 313.
37 *Trans. Amer. Inst. Chem. Eng.*, 1940, *36*, 817; B.C.A., B.I., 1941, 118.
38 *Trans. Amer. Inst. Chem. Eng.*, 1941, *37*, 3; B.C.A., B.I., 1941, 252.
39 *Trans. Amer. Inst. Chem. Eng.*, 1941, *37*, 291; B.C.A., B.I., 1941, 310.
40 *Ind. Eng. Chem.*, 1940, *32*, 1220; B.C.A., B.I., 1941, 2.
41 U.S.P. 2114786; B.C.A., B.I., 1941, 202.
42 *Ind. Eng. Chem.*, 1940, *32*, 1384; B.C.A., B.I., 1941, 2.
43 *Trans. Amer. Inst. Chem. Eng.*, 1940, *36*, 741; B.C.A., B.I., 1941, 47.
44 *Chim. et l' Ind.*, 1940, *22*, 165; B.C.A., B.I., 1941, 81.
45 U.S.P. 2206595; B.C.A., B.I., 1941, 317.
46 *Trans. Amer. Inst. Chem. Eng.*, 1941, *37*, 559; B.C.A., B.I., 1941, 511.
47 U.S.P. 2110504; B.C.A., 1941, B.I., 6.
48 *J. Amer. Chem. Soc.*, 1940, *62*, 2838; B.C.A., B.I., 1941, 46.
49 *Ind. Eng. Chem. Anal.*, 1941, *13*, 28; B.C.A., B.I., 1941, 117.
50 B.P. 529361; B.C.A., B.I., 1941, 85.
51 U.S.P. 2119886; B.C.A., B.I., 1941, 315.
52 B.P. 527210; B.C.A., B.I., 1941, 6.
53 B.P. 529295; B.C.A., B.I., 1941, 86.
54 *Ind. Eng. Chem.*, 1940, *32*, 1580; B.C.A., B.I., 1941, 81.
55 *Trans. Inst. Chem. Eng.*, 1940, *18*, 30; B.C.A., 1940, 332.
56 *Ind. Eng. Chem.*, 1940, *32*, 1329; B.C.A., B.I., 1941, 2.
57 *J. Ind. Hyg.*, 1940, *22*, 276; B.C.A., B.I., 1941, 82.
58 *Rev. Sci. Instru.*, 1940, *11*, 277; B.C.A., B.I., 1941, 2.
59 B.P. 530367; B.C.A., B.I., 1941, 121.
60 B.P. 529540; B.C.A., B.I., 1941, 119.
61 *Bull. Inst. Phys. Chem. Res., Japan*, 1941, *20*, 234; B.C.A., B.I., 1941, 371.
62 *Chem. & Ind.*, 1941, *60*, 430.
63 *Chem. & Ind.*, 1940, *59*, 807; B.C.A., B.I., 1941, 47.

# Pump Design for Chemical Processes

## Service in the Food Industries

CHEMICALS and food have never been more important to the nation than they are to-day. Vital, too, is speed in their manufacture where centrifugal pumps play an essential part by increasing the flow of liquids and in moving them from one place to another. Innumerable processes prepare our foods for consumption and the various chemicals for their uses in industry, and as foods must be kept hygienically pure until delivered to the customer, and chemicals unadulterated, it is often necessary to use pumps specialised for particular uses. Because the efficiency of a pump largely depends on the pump being designed for the particular purpose for which it is to be used, the Pulsometer Engineering Co., Ltd., of Reading, have for some 65 years made it their policy to cater for special requirements, with the result that they have an extremely large range of patterns and can supply a pump for almost any specified duty. Their pumps are all-British and can be relied on for high efficiency, competing advantageously with food and chemical pumps in any market. For general supply, for cooling water or for heating services, where clean water only has to be dealt with, there is a wide range of standard designs. Pumps required for more specialised duties require more detailed description.

### Acid Pumps

The "Pulsometer-Doulton" stoneware acid pump has been designed to meet the limitations of stoneware as a material of construction, the type of stoneware used being a special high-grade ware which has an exceptionally low

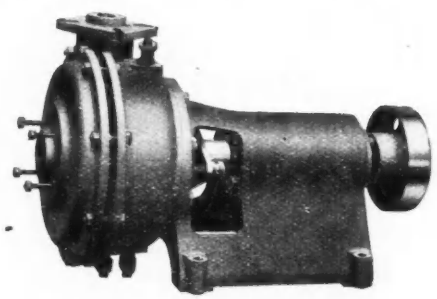


**Fig. 1. Stoneware acid pump dealing with a wide range of liquids**

degree of porosity, a smooth even finish, and a high tensile strength combined with outstanding hardness and abrasion-resisting properties. The interior parts of the pumps are lined with this stoneware, no other material coming in contact with the liquid under treatment, with the result that corrosive liquids can be dealt with without injury to the pump and without contamination or discoloration of the liquid itself. The stoneware will resist all but hydrofluoric acid and is suitable for temperatures up to 100° C. To meet the difficulty of pumping harsh liquors which have no lubricating effect on the bush, this pump has been designed with a special bearing assembly comprising a spindle of extra large diameter supported in double ball and roller bearings carried in a cast-iron hood. The bearings carry the weight of the rotating parts of the pump without the assistance of an internal bush. This type of hood and bearing assembly can also be adapted to any "Pulsometer" end-suction centrifugal pumps to avoid the internal bush difficulty.

While pumps made in special metals, etc., can be used for corrosive liquids, their use is generally limited to one or two individual liquids and by the temperature at which these are pumped. The wide range of liquids for which the "Pulsometer-Doulton" Stoneware Pump can be used will therefore be appreciated. The following are examples of industries in which this stoneware pump is invaluable: foodstuffs, including gelatine, vinegar and pickles, alkalis, bleaching liquors and dyes, artificial silk yarn and cellulose, pharmaceutical and photographic

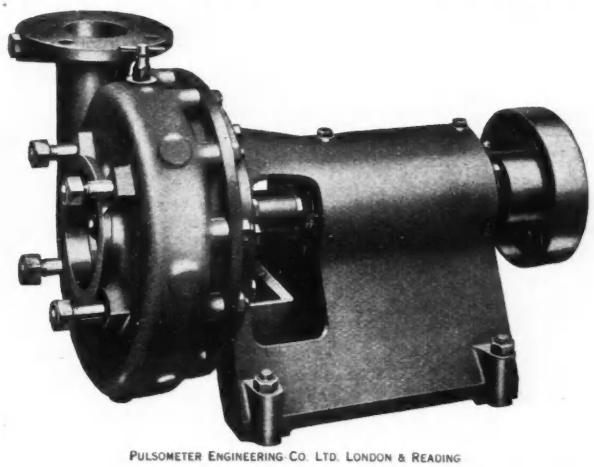



**Fig. 2. Special pump for corrosive-liquid service with contact parts constructed of stainless steel**

materials, the general chemical and electrochemical industries, chromium plating, enamelling, paper mills, etc.

The two-bearing assembly described above has particu- advantages where pumps have to be made of special metals, *e.g.*, stainless steel, acid-resisting bronze, austenitic cast iron, aluminium, etc. Only the pump parts likely to contact deleterious chemicals, such as the casing and impeller, are made of the special metal, the choice being determined by the nature of the fluid pumped. As these metals are expensive, their weight is reduced to a minimum consistent with strength and rigidity. The bearings are specially protected from contact with injurious chemicals, a matter of importance because of the tendency of most chemically-resistant metals to be prone to seizure and because many deleterious liquids have little if any lubricating property.

### High Temperature Pumps

Where liquids such as tar or oils have to be dealt with at very high temperatures, there are "Pulsometer"

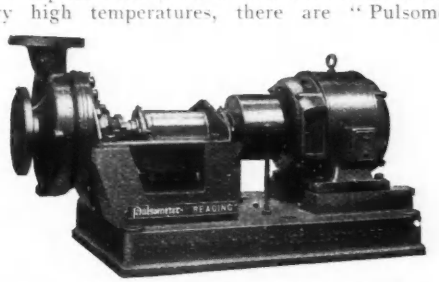



**Fig. 3. The J.B. Pump is one of two ranges of pumps and designed to withstand high-temperature stresses and the pressures involved, and to reduce gland trouble to a minimum**

pumps with water-cooled stuffing boxes and bearings working at temperatures up to 250° C. Through special attention to the design of the stuffing and the choice of packing trouble-free working has been secured.

To meet exacting conditions of absolute purity, the "Pulsometer" Milk Pump, of robust and simple construction, is smoothly finished within and without. There are no crevices where milk may lodge and become sour.

The spindle is made of stainless steel, and the casing and impeller are of gunmetal heavily tinned internally, the tin and stainless steel being unaffected by milk. The pump can be quickly dismantled without tools and the impeller and passages are so proportioned as to reduce churning to a minimum. The pump is suitable not only for milk-like liquids, but also for other liquid and semi-solid food stuffs.

For viscous liquids at high or low pressures, positive, self-priming, valveless "Pulsometer" rotary pumps are

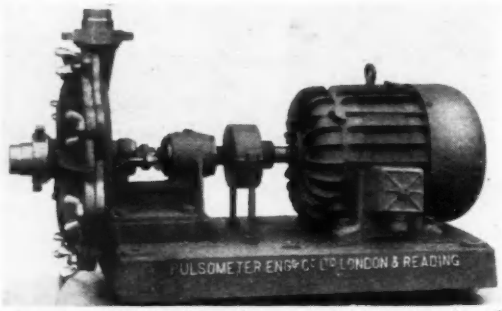



**Fig. 4. 2" high lift milk pump, with a capacity of 1500/1600 gallons per hour**

recommended. These are of high efficiency, durable and reliable and not subject to excessive wear. Owing to their special construction these pumps can deal satisfactorily with such materials as asphalt, bitumen, creosote, tar, cellulose, enamels, paints, lubricating and fuel oils, ink, glue, gum, viscose, chocolate, syrup, glucose, glycerine, or margarine.

*Note.*—Where "Pulsometer" chemical pumps are handling any liquid giving off fumes, a special arrangement can be made whereby the pump can be separated by a wall from the motor.

## Vacuum Pumps

Vacuum pumps play an increasingly important part in chemical research, experiment, and industry. It is safe to say that without their use for high or low vacua, displacement, desiccation, impregnation, distillation, or in moist air circuits, efficiency and progress would in many directions be retarded. Note only some of the industries in which they are necessary: aromatics, artificial silk, beer bottling, benzol recovery, chocolate and coffee manufacture, dairy research, disinfecting apparatus, drugs, dyestuffs, essential oils, food extracts, milk drying, oil refining, refrigeration, safety glass, serum tube filling, synthetics, tar products, tin sealing, tobacco packing, vacuum milking. This list does not include important applications in other industries for cable insulating, electric lamps, mercury arc rectifiers, plastics, etc.

In many of these the highest degree of vacuum is essential and the wide range and high efficiency of "Pulsometer" Geryk vacuum pumps make it possible to suit all requirements. Geryk single stage pumps will give vacua up to .005 mm. and Geryk duplex pumps up to .00001 mm. off perfect. There is practically no limit to the sizes in which these pumps can be made—the largest giving results equal to the smallest, thus making possible operations on a large scale. Special features of construction include automatic internal lubrication (all moving parts running in a film of oil, thus reducing wear and giving the pumps almost endless life), fast pumping speeds, and absolute certainty of action.

## Rotary Pumps

Single-stage rotary vacuum pumps are made in seven stages from a 3-in. to a 12-in. type, capacities ranging from 2 to 123 cu. ft. displacement per minute, and not less than .01 mm. off perfect measured on a McLeod gauge. They can be adapted for use as a pressure pump for moderate pressures or for vacuum and pressure combined, or they can be supplied for desiccation and distillation. Three of these deserve special mention: the 8/50 in. Geryk Pump built for hard wear and to give a large displacement at low cost for factory use, unlike most vacuum pumps is water jacketed, has a capacity of 60 cu. ft. of free air per minute when running at 350 r.p.m., and is tested to a vacuum not less than .005 mm. off perfect. It can be adapted for three different circuits, chemical and dry, and for circuits in which aqueous moisture may be present. A larger improved 12-in. type of the 8/50 in. gives free air displacement of 123 cu. ft. per minute at a speed of 300 r.p.m.

For light duties there is the small, cheap 4 S.T.1 design giving free air displacement of 4 cu. ft. per minute at a speed of 600 r.p.m. and a maximum vacuum of 0.01 Hg. For general purposes a pumping outfit can be supplied which has been designed for use where vacuum circuits are of a variable nature.

Multi-stage pumps can be made either as single units or in duplex form. For instance a six-unit pump can be used as six single-stage pumps or five pumping units backed by a sixth. These pumps are extremely efficient, giving a high degree of vacuum and a fast pumping speed while requiring the minimum of power.

Single-stage pumps are tested to .005 mm. and Duplex pumps to .00001 mm. These are primarily designed for the manufacture of electric lamps, wireless valves, and neon signs, but are suitable for many other circuits.

## Evaporation, Desiccation, Distillation

High-vacuum pumps will evaporate water at a temperature below that of the surrounding air or below the temperature of the cooling water employed in the condenser. They are designed for the many cases in chemical factories when it is desirable to evaporate moisture at a low temperature.

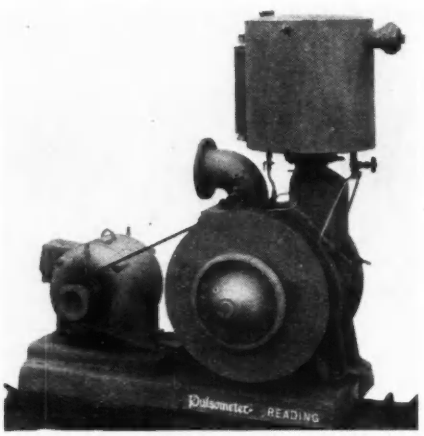



**Fig. 5. 12/50" type of Geryk rotary vacuum pump**

Their efficiency is such that they will evaporate moisture down to 0° F., and they can carry on desiccation to a degree considerably beyond that otherwise possible. The degree of vacuum obtained with the desiccating pumps is less than a millimetre off perfect. For the distillation of fine essences these pumps are invaluable, the most refractory bodies yielding up their vapour readily in the high vacuum produced.

Condenser air pumps of a rotary or reciprocating type, of any size, can be supplied, giving the highest efficiency on a moist circuit which does not require desiccation and distillation pumps. These may be complete units with condensers, vacuum chambers, etc.

"Geryk" vertical reciprocating vacuum pumps fulfil requirements which do not demand the highest degree of vacuum and for use where skilled attention is not available. Simple in construction, automatically lubricated, they can be dismantled in a few minutes if necessary, are tested to a vacuum of 29 in. on a closed circuit and maintain their efficiency for an indefinite period.

# Steam Plant for Cleaning Machinery

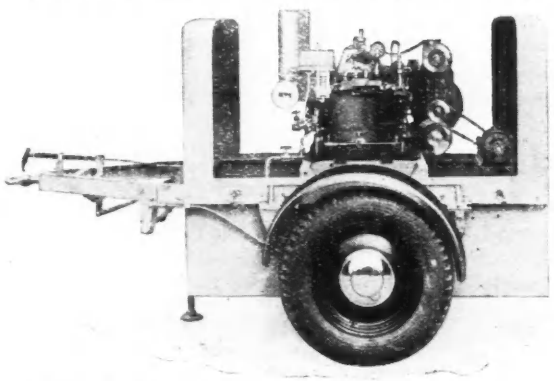
## Portable or Stationary Generators

INSTANTANEOUS steam raising plant can be adapted for the rôle of decontaminating machinery, road transport vehicles, etc., from the effects of war gases. An example of plant suitable for this class of work is the Vapor-Clarkson Generator, manufactured by Messrs. Gresham and Craven, Ltd., Salford, Manchester. This is an automatic oil-fired steam generator of the continuous coil water-tube type. It is compact and portable; the stationary model occupies a space of three feet by two feet, excluding motor, and the portable model, complete with fuel and water tanks, is mounted on a trailer no more bulky than the light trailer pump used for fire-fighting.

In addition to supplying dry or superheated steam, the Vapor-Clarkson Generator can produce high-temperature liquid sprays, at either high or low pressures. The standard unit has a capacity automatically variable from 100 to 300 lb. of steam per hour of dry or superheated steam at pressure up to 200 lb./sq. in.; superheat is adjustable up to 260°-320° C. As the unit has a heat release of over a million B.Th.U. per cubic foot of combustion space, an unusual amount of steam is delivered in relation to size.

The generators are constructed with a patented staggered coil assembly, which can be withdrawn from the unit for cleaning or replacement, by a single operation. The whole of the conversion from water to steam is effected within the compass of this coil, so treated feed water is essential. The coil is made from open-hearth steel tube, while the body and fire components are produced from close-grained cast iron and certain auxiliaries from bronze. The coil is fully compensated for expansion and is designed to split the combustion gases into narrow layers; these gases flow in the opposite direction from the flow of water in the coils, thus resulting in high thermal efficiency. Tecalemit filters are used in the oil feed and a Waynes "Viking" fuel pump controls the supply of the fuel. This pump, the Duplex feed-water pump, the ignition magneto, and the blower fan for combustion air are driven by one unit, which may be either an electric motor or internal combustion engine. The driving assembly is thus somewhat complicated, but good design has made it compact.

In operation the unit is simple but effective. Fuel oil pumped to the atomiser is by-passed by a fuel control valve until water pressure has been built up by the water pump. When the fuel pressure reaches 60 lb./sq. in. the atomiser valve opens and the vaporised fuel is ignited by a sparking plug. The unit is fully equipped with safety devices, and if the steam pressure rises above a predetermined figure, a pressure switch stops the driving motor, restarting it when pressure drops to normal. Similarly, excessive superheat causes a by-pass to reduce the full pressure and amount of oil being fed to the burner. Completely automatic control equipment is available.



**Flash boiler for instantaneous steam generation: portable model**

When it is desired to use the steam generator as a source of hot liquid for cleaning purposes, a second Duplex water-feed pump with a separate set of control valves is brought into operation. As the fuel feed is constant for any speed, and the supply of water is greatly increased, the boiler is unable to convert it to steam, and produces a hot liquid jet which can be regulated in temperature by control of the suction valve in the second feed-water pump. The boiler will not only handle water, but also mixtures of oil and water or certain chemical solutions in water.

## LETTER TO THE EDITOR

### Extinguishing Magnesium Fires

SIR,—Your report in the current issue of THE CHEMICAL AGE of a *new* method evolved by Dr. R. R. Sayers in the U.S.A. of extinguishing magnesium fires by the use of granulated or flaked pitch, particularly interests us as the use of such a material is mentioned in our various world patents for materials and mixture for extinguishing light metal fires and is therefore *not new*.

Over four years ago we experimented with hard and soft pitches amongst other materials and found that whilst *finely ground* (powdered) coal tar pitch was very useful for extinguishing burning magnesium swarf, it suffered greatly from storage and application difficulties and in many cases created a secondary fire. This secondary fire, especially where magnesium incendiary bombs are concerned, could easily assume alarming proportions with considerable glare and smoke, all objects to be totally avoided during air raids.

In industrial fires you may easily have a combination of conditions when machining light metals that would make it very hazardous to use a straight pitch—especially flaked or granulated—and if you have to wait until a temperature of 150° C. is reached before the pitch softens, then machine tools and slides are bound to suffer.

Our "DX" Magnesium Fire Extinguishing Powder has stood the test of time, is extensively used throughout the light metal industry at home and in the Empire and is so made that partial melting takes place at a lower temperature, and during four years we have not received any complaint that machine tools or machines have suffered any harm. "DX" is definitely non-abrasive, and has extinguished many incendiary bombs during air raids without the need for secondary fire extinguishing.—Yours faithfully,

for DURSTON, LANG AND CO., LTD.,
G. HAROLD DURSTON,
Technical Director.

Harrow Weald,
March 6, 1942.

## NEW TRANSLUCENT GLASS

Steam and molten glass combine to form translucent plate glass in a method patented by Arthur Nash and assigned to the Pittsburgh Plate Glass Company. Hitherto, translucent glass has been produced by applying sand blast to glass to roughen its surface. Glass so treated is hard to clean and sand-blasting means the use of an extra operation. By the new process, as the glass is drawn into a sheet from the molten batch, bubbles of steam are blown into it. While the drawing continues the bubbles are "stretched out." A glass results which is non-transparent and possesses a smooth-surface. This glass may be used in place of prism glass for lighting, since light passing through it is directed back horizontally, giving improved lighting in parts of a room away from the window.

# General News——From Week to Week

**The loudest cheer of the week** goes to the man who read the headline, "More Manganese in Russia," and said: "Gosh, I didn't know they were in the war."

**An oil tank exploded** when fire broke out at the Pumpherston Oil Works, Mid Calder, Midlothian, on Friday last week. Two other tanks were damaged, but the main refining plant was saved.

**The annual report on the Fermentation Industries** for 1941, prepared by Mr. A. A. D. Comrie, B.Sc., F.I.C., for the Society of Chemical Industries and the Institute of Brewing, has now been published.

**At the suggestion of the Fuel Efficiency Committee,** the Mines Department, with the co-operation of the Board of Education, has organised a scheme of free training in fuel efficiency. Further information may be had from the Mines Department's Divisional Coal Officer in each area.

**At the annual general meeting of Borax Consolidated, Ltd.,** to be held on March 17, the directors will propose to allocate, subject to the stockholders' approval, the sum of £3000, to be divided equally between the R.A.F. Benevolent Fund and Benevolent Funds for Merchant Seamen.

**The ninth list of donations** to Mrs. Churchill's Red Cross "Aid to Russia" Fund includes an item of £830 3s. 2d. contributed by the Mayor of Widnes. This sum comprises amounts raised in many of the local chemical works, and good progress towards a second instalment is already being made.

**On the instructions of the Iron and Steel Control** a memorandum of the utmost importance to all users and producers of wrought and alloy steels has just been issued by the British Standards Institution (ref. number 970A). It is a revision of B.S. 970, and may be obtained from the B.S.I. for 9d., post free.

**The Minister of Supply** has made the Control of Fertilisers (No.19) Order, 1942, which came into force on March 13, replacing the Control of Fertilisers (No.15) Order, 1941. The principal effect of the new Order is to facilitate the distribution of quantities in lots of less than 6 tons by permitting the general charging of allowances for small lot sales.

**A manufacturer of medicated soap,** who wishes to claim that his soap is used for medical purposes only, and should, therefore, be supplied coupon free, should apply to the Oils and Fats Division, Rothesay, Colwyn Bay, stating the exact composition of any soap for which exemption is claimed. The Oils and Fats Division, in conjunction with the Ministry of Health, will give careful consideration to all such applications.

**The first number for 1942** of *The Advancement of Science* (the report of the British Association for the Advancement of Science) contains a detailed report of the Conference of Science and World Order, which was held in London on September 26-28 last year. For all who are interested in the opinions of the progressive minds in scientific thought, this compact volume of 120 pages is very cheap at the price of five shillings.

**Workers in 40,000 industrial** and commercial establishments throughout England and Wales are now contributing an average of £37,000 a week to the people's Red Cross Penny-a-week Fund. Altogether they have raised nearly £2,000,000. In order to carry out its obligations to the full the organisation now needs a revenue of about £100,000 every week. Employers everywhere can help to accomplish this by bringing the Fund to the notice of their workers, and by affording facilities for collection.

**Inquiries have shown** that many people hoard used cheques indefinitely, in the belief that they have the value of legal receipts. According to a bank official, quoted by the Waste Paper Recovery Association, this is a fallacy. The most that can be said for them is that they might serve, in Court, in certain circumstances, as supporting evidence. There is no good reason why used cheques should be kept longer than six months, or one year at the most. Clients have their regular statements as a record of payments. There must be millions of old cheques tucked away and forgotten in homes and offices all over the country, and they might well go to make munitions.

**It has been decided** that capsicin (oleoresin of capsicum), gingerin (oleoresin of ginger), and essence of ginger will not be regarded as chargeable with Purchase Tax, unless they are sold put up for medicinal use. Capsicin water-soluble is not chargeable. Drugs which fall within Class 19—*e.g.*, caffein, calcium, glycerophosphate, and quinine and its salts—are chargeable in all cases whether for use in the manufacture of beverages, or otherwise.

## Foreign News

**Twenty plants in Canada** are engaged in the manufacture of war chemicals (12) and explosives (8), and one of these is the largest chemical plant in the British Empire.

**Synthetic rubber** is now being manufactured in the chemical plants of the State Coal Mines in the Limburg Province of Holland, according to the official German News Agency.

**Valuable supplies of base metals** have been discovered in Kenya, particularly in the South Kavirondo district, where a Canadian mining concern has found copper, iron, zinc, and lead, according to a Reuter message from Nairobi.

**Iron oxide, both natural and synthetic,** is produced in Brazil, and a synthetic iron-oxide factory was recently established in Rio de Janeiro. Imports of iron oxide into Brazil amounted to 19,623 kg. in 1940, compared with 41,552 kg. in 1939.

**Steel ingot production** in Canada during the first eight months of 1941 amounted to 1,548,000 long tons, and pig-iron output to 833,000, as compared with 813,000 and 422,000 in the corresponding period of 1939, the latest comparable pre-war year.

**The power and industrial plant at Mazingarbe,** between Lens and Bethune, which was heavily bombed in September last, has again received attention from the R.A.F. An attack by bombers and fighters on the factories there, which include important chemical works, was carried out last Monday afternoon.

**South African output of tin concentrates** may well be increased from the normal annual average of 1000 tons per annum, to the figure of about 3000 tons, which was the approximate yearly average in 1910-18. Far Eastern conditions have directed attention to the possibility of increasing output both of alluvial tin in Cape Province and Swaziland and from the "pipe" deposits in the Transvaal.

**New construction** for the American Zinc Company of Illinois includes doubling of the electrolytic unit at Monsanto, Montana, a flash roaster and contact acid plant, additional smelting blocks, Waelz and by-product units, and other plant at Fairmont, Illinois. These will increase the combined capacity of the company's two plants by about 2000 tons of slab zinc per month.

**Metallic cadmium** produced in the U.S.A. reached a record figure in 1941, according to the Bureau of Mines. Production of primary metallic cadmium increased about 15 per cent. to 6,840,000 lb. in 1941 compared with 5,921,488 lb. in 1940. Imports of metallic cadmium in the first nine months of 1941 totalled 147,378 lb., of which 136,280 were from Canada and 11,098 from the United Kingdom.

**Existence of workable deposits of bauxite** in the Shevaroy Hills, 200 miles S.W. of Madras, was recently revealed by the Government of Madras, and the ore is said to be suitable for aluminium manufacture. Exploitation of the deposits apparently presents little difficulty, and local authorities are of the opinion that with large-scale activity annual production of bauxite should reach at least 100,000 tons.

**Great increases were effected** in the amount of material mined and treated during 1941 by the South African Torbanite Mining and Refining Co., Ltd. Tons of torbanite mined totalled 95,939 (as against 57,072 in 1940); tons retorted were 90,095 (55,747); gallons of crude oil yielded, 4,200,915 (2,539,040), recovery per ton in gallons 46.2 (45.5). The increased figures are consequent upon an agreement with the Union Government to maintain production of petrol from torbanite crude oil at three million gallons per annum.

# Forthcoming Events

A series of three Cantor lectures on "X-Ray Technique in the Industrial Laboratory" will be delivered at the **Royal Society of Arts**, by Mr. H. P. Rooksby, B.Sc., F.Inst.P., on **March 16, 23** and **30.**

A joint meeting of the Pottery, Refractory Materials and Building Materials Sections of the **British Ceramic Society** will be held on **March 17,** at 11 a.m., at the North Staffordshire Technical College, Stoke-on-Trent, when a series of papers on Kilns will be read by Mr. W. Noble, B.Sc., Mr. A. T. Green, F.I.C., and Mr. L. Bullin, B.Sc.

There will be a meeting of the **Royal Society of Arts** at John Adam Street, Adelphi, at 1.45 p.m., on **March 17,** when a paper on "Recent Developments in the Scientific and Industrial Research Programme of New Zealand," by Dr. Ernest Marsden, C.B.E., M.C., secretary of the Department of Scientific and Industrial Research of New Zealand, will be read by Mr. Neville Wright.

There will be a joint meeting of the **Institute of Chemistry** with the London and Home Counties Section of the **Institute of Physics,** at the Royal Institution, on **March 18,** at 2.30 p.m., when Professor M. L. E. Oliphant, F.R.S., will lecture on "The Applications of Nuclear Physics in Chemistry and Biology."

A meeting of the Manchester Section of the **Oil and Colour Chemists' Association** will be held at the Engineers Club, Albert Square, at 2.30 p.m., on **March 18,** when Mr. J. G. Gillian, B.Sc., Ph.D., A.R.T.C., will deliver a lecture on "Some Aspects of Camouflage."

A meeting of the **Institute of Fuel,** to which friends are cordially invited, will be held at the Connaught Rooms, Great Queen Street, W.C.2, on **March 19,** at 2.30 p.m., when Dr. Ezer Griffiths, Dr. R. W. Powell, and Mr. M. J. Hickman will present a paper entitled "Thermal Conductivity of Some Industrial Materials."

Following the annual general meeting of the Birmingham and Midlands Section of the **Society of Chemical Industry,** to be held in the Birmingham Chamber of Commerce, at 6.15 p.m., on **March 20,** Professor F. L. Engledow will deliver the Jubilee Memorial Lecture on "Science and the Land."

# Chemical and Allied Stocks and Shares

ALTHOUGH the war news continued to dominate the stock and share markets and made for further contraction in the volume of business, there was again little selling, and movements in security values were moderate in character. Chief attention was given to British Funds and high-grade investment securities, which were higher on balance, although in many directions best prices touched in the past few days were not fully held. Individual features of interest were not lacking among industrial shares, but no very definite trend has developed at the time of writing.

Imperial Chemical reacted slightly on balance, from 32s. 7½d. to 32s. 1½d., but, at the time of writing, the 7 per cent. preference units are 35s. 3d., compared with 35s. a week ago. Although it is realised that, in view of the widespread interests of the I.C.I. group, the Far Eastern war developments will affect the company's future earnings to some extent, the market remains very hopeful that the dividend for the past year may be kept on an 8 per cent. basis. Borax Consolidated deferred were firmly held, but at 29s. were little changed in price, despite the good impression created by the full report and the statements therein regarding the company's trading experience. Elsewhere, B. Laporte remained firm, and continued to be quoted at 63s. 9d. Fison Packard were little changed at around 39s. 9d., while Cooper McDougall kept at 24s. 4½d. Results of the last-named company fall to be issued this month.

Lever & Unilever moved down on balance from 26s. 3d. to 25s. 9d. sentiment having been affected by the view that the extension of the war may mean that earlier market hopes of a small improvement in dividend may not be realised, because the directors may decide to deal even more conservatively with future profits. In other directions, Amalgamated Metal shares were inactive around 13s., awaiting the dividend decision. At the time of writing, there has been a steady tendency in British Aluminium and British Oxygen, which at 44s. 3d. and 67s. 6d. respectively, were unchanged on balance, awaiting the results for the past year's working. United Molasses fluctuated moderately, and as compared with a week ago, have gone back from 31s. 6d. to 30s. 1½d., although in this case the market remains hopeful that a moderately higher dividend may be in prospect. The units of the Distillers Co., which were 76s. 3d. a week ago, have since reacted to 74s. 9d. Other shares which were affected by the general market trend included Murex, which were around 87s. 6d., and Turner & Newall, the latter being 68s. 1½d. at the time of writing. Greeff-Chemicals 5s. ordinary units continued to be quoted at 5s. 7½d., and Monsanto Chemical preference shares at 22s. 6d.

There were a number of dealings among shares of companies connected with plastics: British Industrial Plastics 2s. shares were 3s. 3d., and Erinoid 5s. ordinary were around 7s. 6d. The shares of the Valor Co. kept at 31s. 3d., following the dividend announcement. British Match were a steady feature at 35s. 6d., but elsewhere, Wall Paper Manufacturers deferred units moved down from 24s. to 23s. Goodlass Wall 10s. ordinary were inactive, but were again around 9s. 6d., while in other directions, General Refractories at 8s. 10½d. were unchanged, pending publication of the financial results. On the other hand, in common with shares of companies with interests and investments in Australia, Imperial Smelting ordinary moved lower, and were 8s. 6d. compared with 9s. 3d. a week ago.

Associated Cement at 48s. 1½d. were little changed in advance of the dividend announcement. Elsewhere, British Plaster Board were again fairly active and at 21s. 9d. were virtually the same as a week ago. Triplex Glass were around 31s. 9d., while in advance of the dividend declaration, United Glass Bottle were firm at 55s. Rather lower prices ruled for iron and steel issues, including United Steel, Dorman Long, and Tube Investments, although Richard Thomas shares were inclined to improve. Boots Drug 5s. ordinary were 32s. 3d., and British Drug Houses 25s. Burmah Oil and "Shell" were lower among oil shares, having remained under the influence of war developments.

# Commercial Intelligence

**The following are taken from printed reports, but we cannot be responsible for errors that may occur.**

## Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

COOPER McDOUGALL & ROBERTSON (IRELAND), LTD., Dublin, mfg. agricl. & gen. chemists., &c. (M., 14/3/42.) Feb. 11, £15,000 debs.; general charge. *Nil. Apr. 11, 1941.

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# Company News

**Benzole and By-Products, Ltd.,** report a dividend of 3 per cent. on the 6 per cent. cumulative participating preference shares for the half-year to March 31, 1931.

**Milton Proprietary, Ltd.,** report a net profit, for the year ended September 30, of £41,677, and have declared a dividend of 12½ per cent. on ordinary shares.

**Scottish Agricultural Industries** (controlled by Imperial Chemical Industries), report that interest and dividends declared by subsidiary companies for year ended June 30 amounted to £96,309 (£98,948), and announce an interim dividend of 5 per cent. on ordinary shares, the final payment for the year.

The directors of **Borax Consolidated, Ltd.,** are recommending, in respect of the year ended September 30, 1941, the following dividends, less tax: a final dividend of 3 per cent., making 6 per cent., for the year, on the preferred ordinary stock (same); and a dividend of 7½ per cent. (same) on the deferred ordinary stock, both payable on March 26. The balance of profit for the year was £554,996 (£464,148), and after providing for depreciation, pensions, service of debentures, etc., the net profit amounts to £354,171. Meeting, Winchester House, E.C.2, March 17.

# British Chemical Prices

## Market Reports

A STEADY demand has been witnessed on most sections of the industrial chemicals market during the past week and dealers report a fair weight of contract renewal business. The price position remains more or less unchanged, but quotations on the whole display a firm undertone. Amongst the soda products there is a brisk demand for the hyposulphites, and both bicarbonate and chlorate of soda are in strong request. Supplies of yellow prussiate and bichromate of soda continue to be below current requirements, and similar conditions are ruling in the potash section for bichromate and yellow prussiate of potash. There has been a steady inquiry for acetone, formaldehyde, borax, arsenic, and the lead oxides. Amongst the acids, oxalic, citric, and tartaric acids are all firm, and the demand for acetic acid continues unabated. Market conditions for the coal tar products show no material change on the week, and prices for most items remain steady at recent levels. The distribution of xylols and the heavy solvent naphthas is now subject to control, but without any noticeable effect. No further news is yet available in regard to the control scheme for cresylic acid. An active demand is reported for the creosote oils and for crystal carbolic, and there is also a steady demand for naphthalene.

MANCHESTER.—Textile and allied chemicals are meeting with a fair demand on the Manchester market, and the call for supplies from most of the other leading industrial consumers, especially against contracts, has been on steady lines. A certain amount of new inquiry has been in circulation, but in a number of instances it is difficult to place orders for near delivery dates. Among the tar products, pitch is in moderate demand, with xylol not too active and somewhat easier, but in other directions business is steady.

GLASGOW.—Business in the Scottish heavy chemical trade is very quiet in the home market. Export business is extremely difficult and the delivery problem is also becoming rather acute. Prices still maintain their high level.

### Price Changes

**Copper Sulphate.**—MANCHESTER: £31, less 2%, in 5 cwt. casks, f.o.b. Liverpool.

**Formaldehyde.**—MANCHESTER: 40%, £23 10s. to £26 per ton in casks, according to quantity, d/d.

**Pitch.**—MANCHESTER: £42 6s. per ton, at works.

**Xylol.**—MANCHESTER: 3s. to 3s. 5d. per gal.

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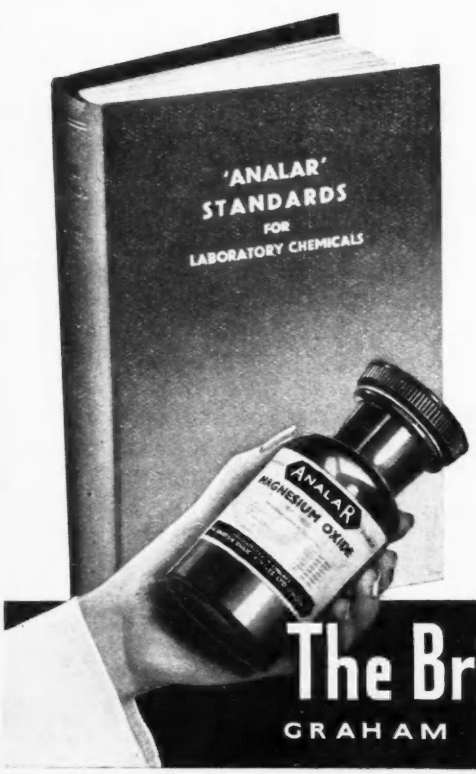


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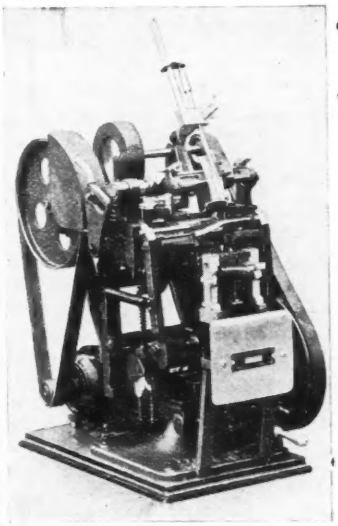

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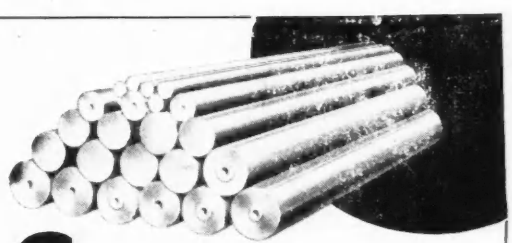

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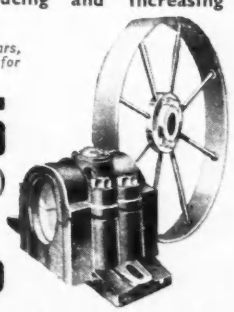

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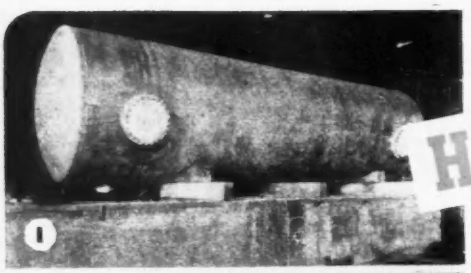

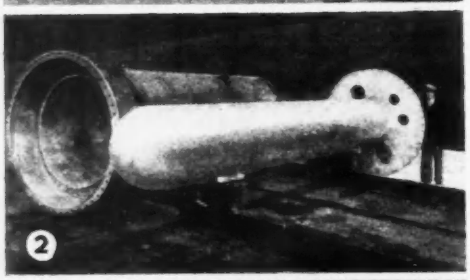

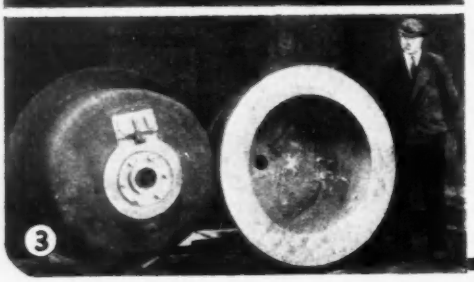

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